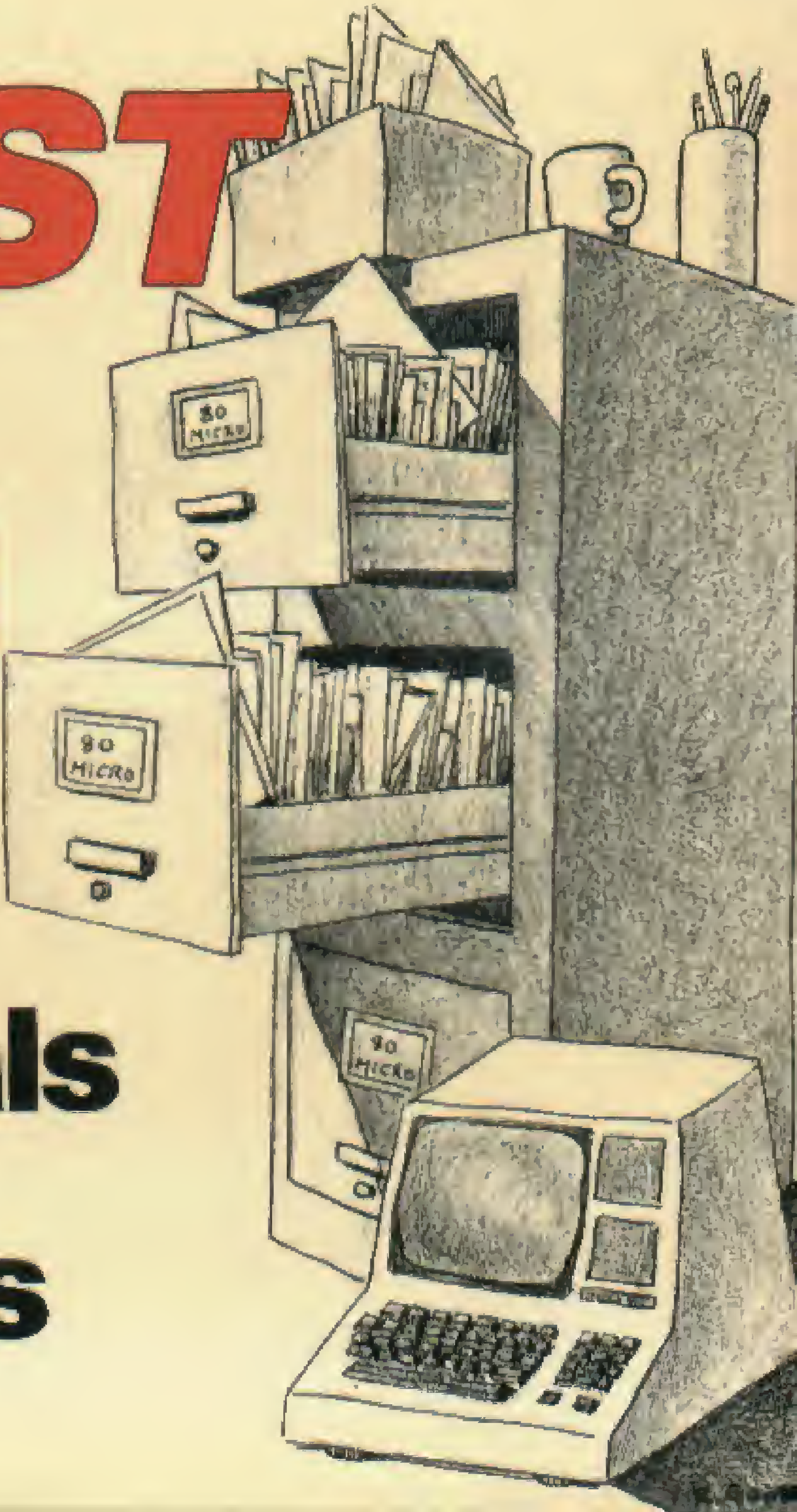
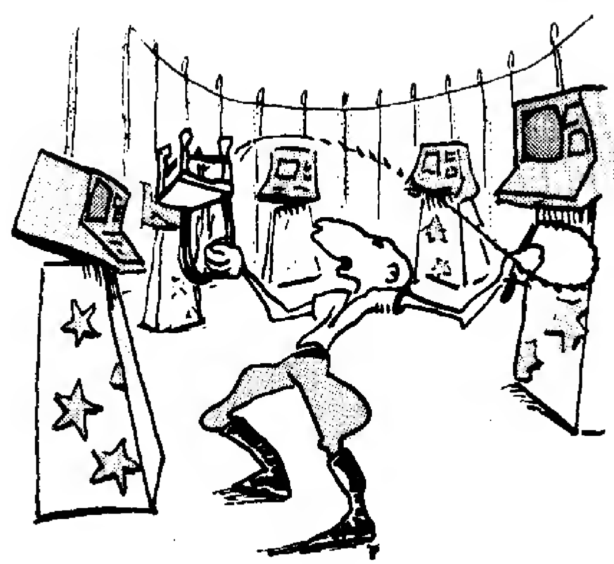
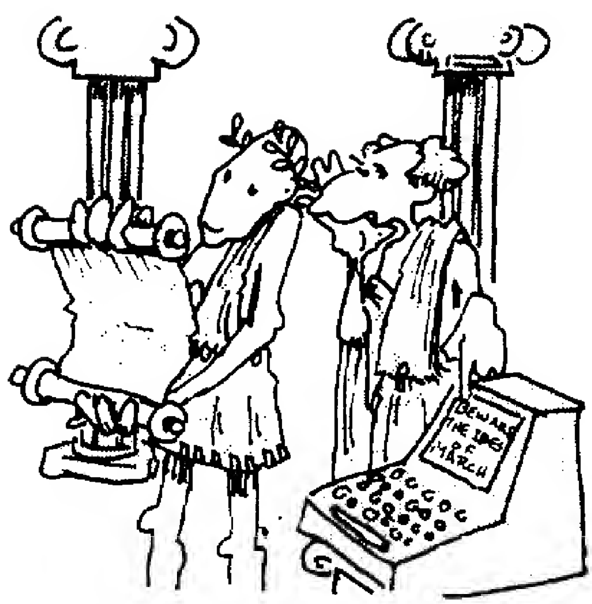
THE REST OF 80



all new tutorials and utilities

The Rest of 80




BEWARE
THE IDES
OF
MARCH

The Rest of 80

A Wayne Green Publication
Peterborough, New Hampshire

Published by
Wayne Green Books
Peterborough, New Hampshire 03458

ISBN 0-88006-062-X

Cover design by Gary Ciocci
Cover illustration by Roger Goode

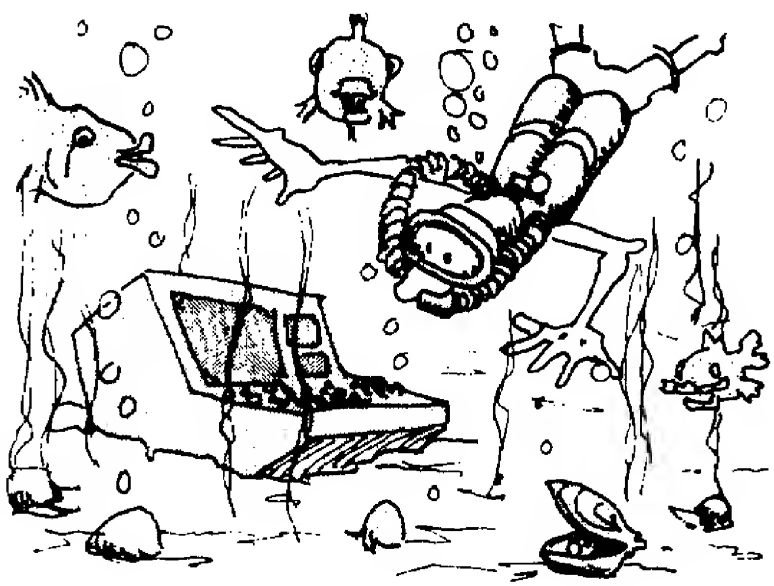
Table of Contents

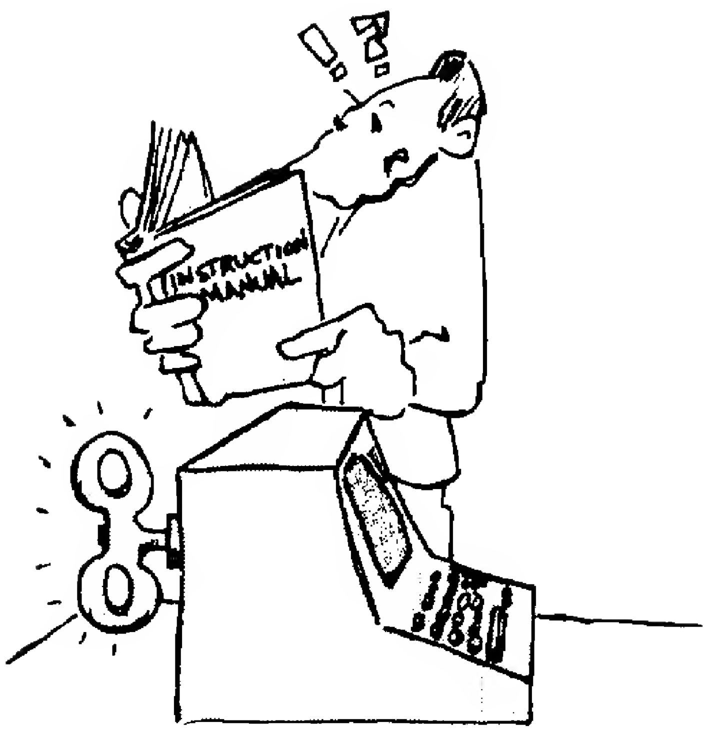
Introduction

The people at *80 Micro* hate to turn down good manuscripts. The problem is trying to fit them all in the magazine. So somebody came up with the great idea: "Let's take the best of the 'rest' of *80* and publish them in a book!"

Here it is.

We've taken special care to edit and design this book for easy use and long life. We know you're going to want it around. Never before published anywhere, these thirty-one tutorials and utilities represent some of the very best manuscripts ever sent to *80 Micro*. Enjoy!




INSTRUCTION
MANUAL

1

Going Beyond Sequential and Random Access

by Bradford Russo

All data processing requires the storage of data on a peripheral mass storage device. For most microcomputers, this means disks. TRSDOS and most other microcomputer operating systems only support two fundamental file access methods, sequential and random. Both have limitations.

Sequential Access

Sequential access was the first method used in data processing, because of the nature of the first mass storage media. To read any given piece of data from punched cards or from magnetic tape, it was necessary to read through all the records that came before (Figure 1). The sequential access technique led to batch processing, which has some major disadvantages. The most obvious problem is time lag, since data is not processed until a batch, typically a whole day's or week's worth of activity, accumulates. For example, data affected by activity on Monday may not be brought up to date until Friday.

This earliest of file access methods is also available on microcomputers. In sequential accessing, the computer stores data (in ASCII code) in the same order it is written, starting at the beginning of the file. Sequential filing is handy when you need to store only one or a few variables worth of data. It's also useful when data is needed in RAM in the form of a table or a set of subscripted arrays. You can use simple and effective FOR-NEXT loops to read the data into and out of RAM. The limited accessing capability becomes unimportant, since once the data resides in RAM it can be accessed in many ways.

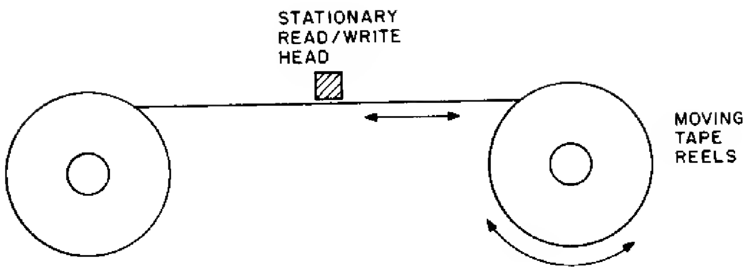


Figure 1

Random Access

The random file access technique was developed next, after the advent of mass storage media which could be read in non-serial order, including drum and disk. The read/write head on disks not only reads serially around one track, but can also move sideways from one track to the next (Figure 2). Multiple platter disk drives also read up and down along a third dimension by selecting the desired platter from a stack of several (Figure 3). These new storage devices led to interactive and real-time processing methods. The advantage to real-time processing is its instantaneous updating of data. This is very useful, for instance, in a business inventory control system. New shipments can be recorded immediately instead of waiting for a complete batch to be processed.

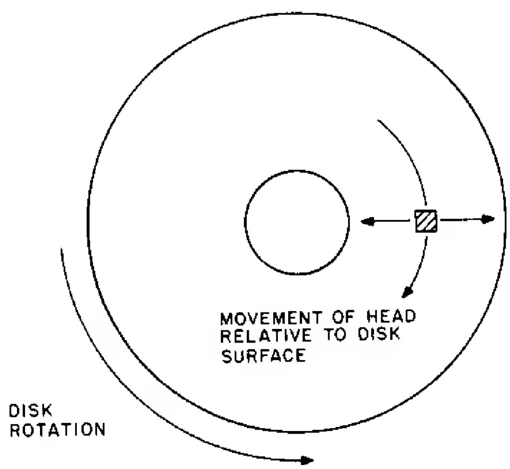


Figure 2

The process of jumping from one given record to any other record resembles random movement; however, the process is more accurately

described as direct or relative. Direct means the computer can go directly to a given record, without reading all the intervening records; relative means that a particular record is referenced by its location relative to the beginning of the file. In other words, record number 126 is the one hundred twenty-sixth record from the beginning of the file. For example, assume the file contains records sized so that exactly ten of them fit on one track of the disk. The first track of the file contains record numbers 1–10. The second track holds 11–20, and so on. To locate record number 126, the computer first moves to the thirteenth track, which holds records 121–130, then reads around the track from 121 to 126. This two-dimensional read process only requires $13 + 6 = 19$ reads to find record number 126. That's a lot faster than a sequential read (Figure 4).

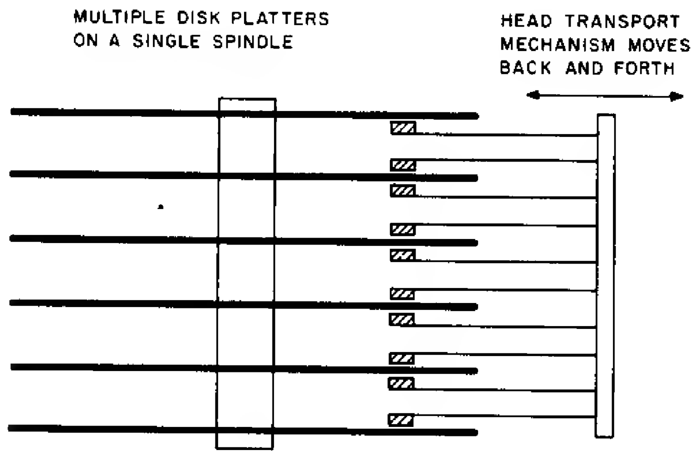


Figure 3

In random access files, a record is referenced by a numeric value called the record number. Each record of the file must have its own identifying number. For example, in a payroll package, the data pertaining to a given employee could be identified by the employee's clock number. If the employees are numbered serially, from 1 on up, clock number becomes synonomous with record number. The identifier (clock number) is directly related to record number. You can also use random access to store data whose identifiers are non-numeric. An example of this is a file storing a record for each day's activities, using dates as identifiers. The record storing data for the fifth of March would have an identifier of March 5, which translates into physical record number 64 by the following process: since there are 31 days in January, and 28 in February, that means March 5 is $31 + 28 + 5 = 64$ days into the year.

Sometimes the identifier cannot be directly related to record number. Suppose the identifier is to be Social Security number instead of clock

number. A Social Security Number is nine digits long, so any one person must fall between 100-00-0000 and 999-99-9999. That represents 899,999,999 possible combinations, which would require nine hundred million records. If your company has only one hundred employees, that means nine million records are wasted for every record actively used. Such a waste is impossible, of course, since there isn't that much on-line storage available on your computer.

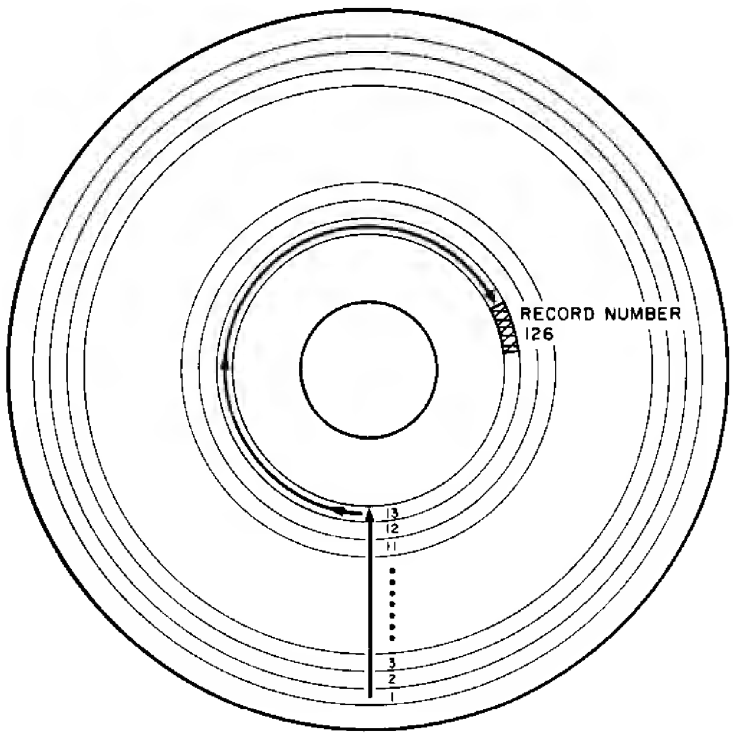


Figure 4

It would be more practical to relate the 100 identifiers (100 employees) to a file of a little more than 100 records. The earliest technique developed to do this is called hashing. In hashing, the relationship between identifier and record number is no longer direct, but is based on a mathematical formula—an algorithm devised for reducing the widely varying identifiers down to a condensed set of record numbers. Occasionally, two or more identifiers hash down to the same record number. This is called a collision, and the identifiers are called synonyms. The hashing algorithm must have provisions for handling these incidents.

ISAM or Keyed Index

Another technique for relating an identifier to a record number is commonly known as ISAM (Indexed Sequential Access Method), or keyed index. The unique identifier of a record is called the key field, or key. ISAM is not supported by TRSDOS or by most other microcomputer operating systems; however, it is available for the TRS-80 Model II in the compiler version of BASIC, as well as FORTRAN and COBOL. You can create an indexed access method under TRSDOS by combining the sequential and random methods.

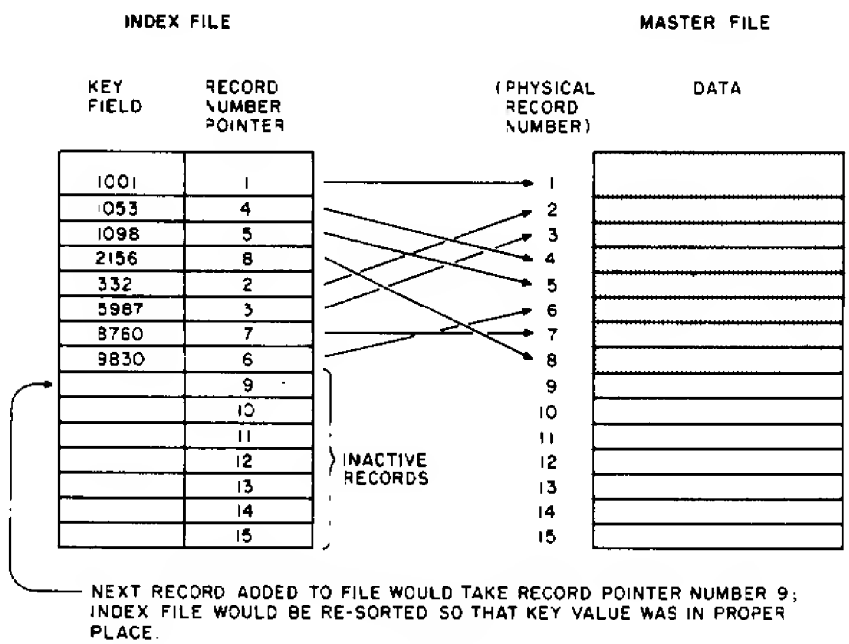


Figure 5

Two separate files are required for an indexed technique. One is the master file, which holds all the data which is to be stored. The other is an index to the master file. Unlike hashing, there is no mathematical relationship between a given key (identifier), and its associated record number. The number is not derived from the key, but assigned arbitrarily. When data is added to the master file, it is placed in the next available physical record on the disk. This record's number is placed in the index file beside its associated key (Figure 5). An indexed technique does not waste disk space for keys that might exist, as direct random access does. It only consumes space for keys which are actually being used. When a record is deleted from the master file, that space is recovered and can be used later, to hold new data (Figure 6).

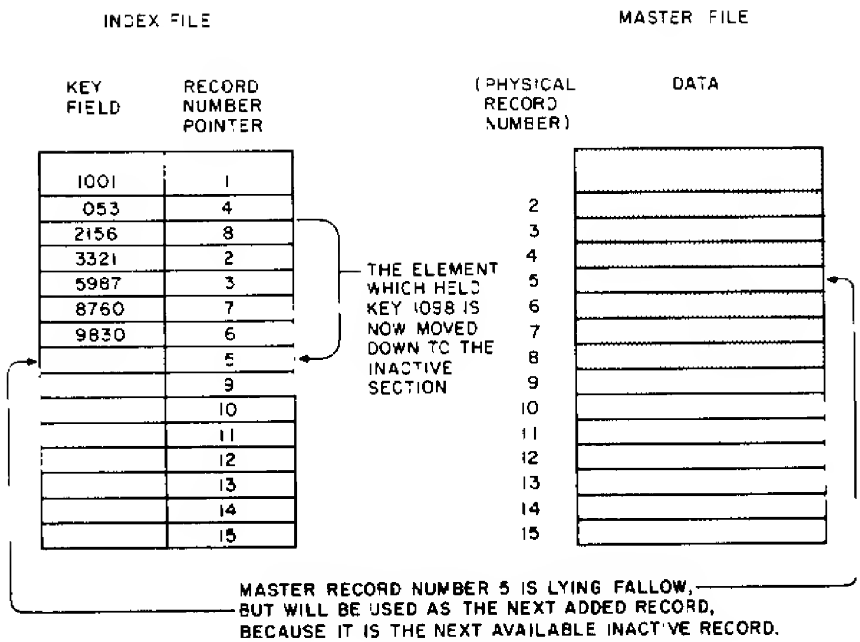
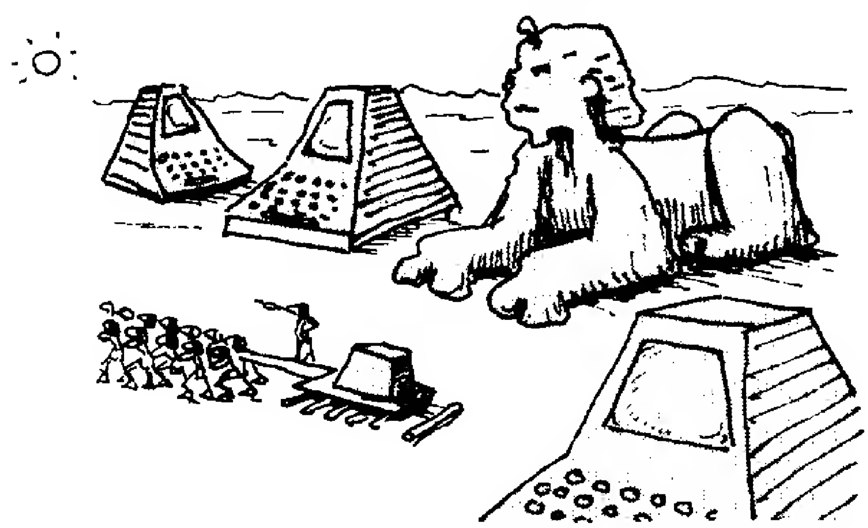


Figure 6

In order to read data from the master file, the index file is first searched for the requested key. That key has an associated record number beside it, which is used to read the appropriate record from the master file. Usually, the index file is sorted by key. You can use a serial read of the index file, key by key, to produce reports in key sequence.



2

An Unlistable, Unbreakable Program

by Jon Boczkiewicz

System Requirements
Level II BASIC or
Disk BASIC
Model I or III

Have you teachers ever wanted instructional programs your students could not break to find the answers? A simple POKE command disables the BREAK key. However, students soon learn they can load and list a program before they run it. Here is my simple method for making your own programs unlistable and unbreakable. You can use it with any program, although Disk BASIC requires different numbers than Level I or II. The technique involves breaking the problem into two parts, because solving one problem creates another.

Make It Unlistable

The first step is to make the program unlistable. While the available numbers using two bytes run to 65535 (256 times 256 minus one), line numbers are limited to 0–65529. I do not know what these last six numbers are reserved for, but a program line number in this range causes a syntax error message. The computer keeps track of where to go by requiring the first two bytes of a program line to be the address of the beginning of the next program line. The second two bytes of the program line are the line number. After you write and debug a program, change the first line number to a number greater than 65529. Listing the program causes the first line to be read as a number higher than the limit, and a READY message appears. It does not affect the program to have a line number higher than acceptable.

You can change a line number with a POKE. The problem is knowing where to POKE. Remember the memory map in Appendix D of your

Level II BASIC Reference Manual? A look at the map shows the BASIC program text starts at memory location 17129. This location contains the first byte of the first program line. Bytes three and four (the line numbers) must be in memory locations 17131 and 17132. So after the program is running and debugged, save and back up your own copies, strip all the comments out of the program in the computer, and compress it, if you can. Then, from the command mode, POKE 17131,251 (or higher) :POKE 17132,255. It should now be unlistable. Run the program—it should be unchanged, except for a small problem with GOTOs or GOSUBs.

GOTOs or GOSUBs find their target line by going to the start of the program and looking for the line number, starting with the first line. But now the first line has a number that is higher than the highest allowed. The solution is simple—undo what you have done. You POKEd numbers into memory locations 17131 and 17132 to change the line number. Now POKE the original numbers back, but this time from *within* the program. Your first program line (the one which gets renumbered) can do this. You can use a special line:10 POKE 17131, 10:POKE 17132, 0. But this leaves you right where you were, able to load, run, break and list the program.

Make It Unbreakable

You could disable BREAK by POKEing 16396, 23 and later enable it by POKE 16396, 201, but if you have a mean streak, try the following sequence: POKE 16396, 62: POKE 16397, 187: POKE 16398,0. This redefines the BREAK key to NEW, and wipes out the program whenever the key is hit. Or, you can POKE 16397 with any of the internal codes for the BASIC keywords from Appendix E of the *Level II BASIC Reference Manual*. The program then runs as desired, including GOTO and GOSUB, but whenever you press BREAK, the program is NEWed. This will not work if you have had Radio Shack's lowercase modification installed; instead you get whatever symbol has the ASCII number you POKEd into 16397. If you are using Disk BASIC (version 2.2 or higher), POKEing 16396,23 causes the system to reboot when you press BREAK.

You must consider two other possibilities for program security. First, a student could run the program to its end, then list it. This is prevented by the END statement which POKEs 17131,251 and 17132,255, and enables BREAK with POKE 16396,201. The program should have only one END statement, and all other ending points should GOTO this statement. Second, a student could deliberately or accidentally make an error that would cause the program to break and list before running again. Lessen the chance of this by using error traps. These can be statements that require re-entry of wrong data, or a simple GOTO that sends execution to the END statement. The only essential condition is that the program end through a single statement.

The Code

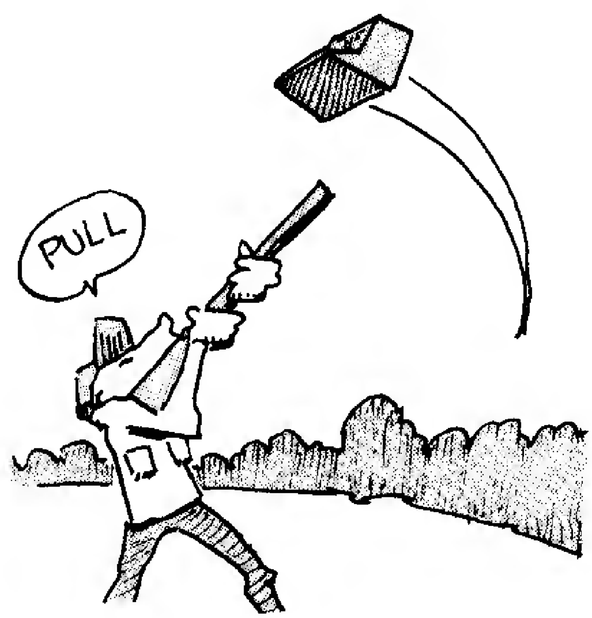
To use this technique, make the following line the first line of your program:

```
10 POKE 17131,10:POKE 17132,0:POKE 16396,62:POKE 16397,187:POKE 16398,0
```

If the line number you select is 5, POKE 17131,5. Now add the ending line as follows:

```
XXXX POKE 17131,251:POKE 17132,255: POKE 16396,201:END
(or NEW instead of END).
```

If the program is in Disk BASIC 2.2, replace 17131 with 26304 and 17132 with 26305. In Disk BASICR 2.2, use 26959 and 26960. Otherwise, everything is the same. To check, run the program. Everything should work except BREAK. Now, in command mode, POKE 17131,254:POKE 17132,255 or 27754 and 27755, if in Disk BASIC. Try to list it—it should not work. You can save the program on tape or disk, load it with no special effort, and run it.



3

Form Fillout Technique

by Gary S. Lindsey

System Requirements:
Level II BASIC
Model I or III

Have you ever considered the time and the number of programming steps it takes to write the code for the entry, viewing, editing, and reviewing of data? When your program requires a lot of data entry, using a form fillout program can save both programmer and user a lot of time and aggravation.

This process involves displaying a form, often with data included, on a screen with protected fields. The user enters into the free fields new or modified data by overwriting all or part of the data. Then the user presses a combination of keys to transmit the new or modified data back to the computer. The computer takes the data and converts it to the variables necessary for processing.

The programs in this chapter allow a programmer to implement a version of the form fillout technique on the Model I TRS-80. Program Listing 1 is written in assembly language for the Z80 microprocessor. Program Listing 2 is written in BASIC to load and demonstrate the assembly-language program. The use of assembly language is necessary for speed and the implementation of commands that are not available in the BASIC interpreter.

In my system, I have placed the BASIC subroutines necessary to implement the form fillout program in ASCII disk files that can be appended to any BASIC program. The program listings in this article are designed for a 48K disk system. I tested all conversions on my system by disconnecting the disks or expansion memory and by setting the memory size to the appropriate values.

Implement the form fillout technique by including two subroutines, 50000 and 60000, in a BASIC program. Subroutine 50000 loads the assembly-language program into memory. Subroutine 60000 places certain BASIC variables which describe the data to be processed into memory for use by the assembly-language program, and calls the assembly-language program. The BASIC program places variables, prompts, and titles on the screen. The assembly-language program accesses the variable data directly from the screen, allowing changes. The variables are then sequentially placed directly into the memory allocated by the BASIC interpreter for the variables A$(1) through A$(N). The assembly-language program handles the data from the screen as ASCII characters. When control is returned to the BASIC program, the new or modified data is present in the A$(I) variables in the order that they appeared on the screen. The BASIC program must convert the A$(I) variables into the appropriate program numeric and string variables.

The BASIC interpreter in the TRS-80 locates string variables through the use of a 3-byte description of the string. Byte 1 contains the length of the string; bytes 2 and 3 contain the memory address of the string pointer. The address of this 3-byte description is determined by using the VARPTR(A$(1)) BASIC command, which returns the address of byte 1 of the description of A$(1) variable through the use of this command, and POKEs it into particular memory locations for use by the assembly-language program. Since the 3-byte descriptions for all A$(I) variables are contiguous in memory, it is only necessary to pass the address of the A$(1) string to the assembly-language program.

Because the assembly-language program writes data directly into the A$(I) locations up to the allowable lengths of the variables, the A$(I) variables must be expanded to their maximum possible lengths before the assembly-language program is executed. Without this step, the A$(I) variables may be of any length when the assembly-language program is called, and you may destroy the validity of the 3-byte description by writing more or less data into a variable than the BASIC interpreter is expecting.

Using the Form Fillout Program

The assembly-language program interprets the six possible operator commands and responds appropriately.

- The left and right arrows move the cursor within the variable being worked.
- The up and down arrows move the cursor to the first position of the next or the preceding variable. The up and down arrows can be used at any time, independent of the cursor position within the variable, without changing the variable. Previous changes to the variable are not disturbed.

•The carriage return works like the down arrow if the cursor is in the first position of the variable. If the cursor is anywhere else and a carriage return is entered, the remaining portion of the variable is filled with blanks. This makes new data entry easy since, under BASIC, the carriage return terminates entries to the computer.
•Pressing the equal sign stores the variable data from the screen into the RAM used by the BASIC interpreter for storage of the A$(I) variable and returns control to the BASIC program.

The data on the screen is changed at the cursor location whenever a character is entered that is not one of the control characters mentioned above.

Implementation of the form fillout subroutines in a program is very simple, as illustrated in the accompanying demonstration program. The following steps must be taken in order:
•Set the memory size to 65217 for a 48K configuration.
•Load the assembly-language program with a GOSUB 50000 at the beginning of the program.
•Clear the screen and print the form and its variables on the screen. The variables are detected by the assembly-language program by the presence of a colon (:). The screen must be printed with a colon and two blank spaces preceding each changeable variable. Since the assembly-language program searches for a colon as the start of variables, you can protect variables from modification by preceding them with any character except a colon. The assembly-language program searches for the colons, skipping over any data on the screen prior to reaching a colon.
•Define N as the number and L(I) as the lengths of the variables. GOSUB 60000 stores these variables in memory for use by the assembly-language program and calls the USR program.
•Convert the A$(I) variables returned by the assembly-language program into the appropriate program string and numeric variables.
•Proceed with the user's program.

Sample Outputs

To illustrate the use of the form fillout program, I have included some sample outputs from the demonstration program. Figures 1, 2, and 3 show the three screen displays before any data has been entered into them. Note in Figure 2 that the numeric entries are shown as zeros. Also note that a blank space for the sign has been included for the numeric values. The BASIC interpreter adds these blanks. You don't need to include the space when you enter data onto the screen. Figure 4 shows Display 1 with a portion of the data entered, and Figure 5 shows Display 1 with a complete set of data.

Figure 6 shows Display 2 after the NAME has been entered using Display 1. Note that the NAME prompt and variable are separated by an as-

terisk. The asterisk means that the NAME cannot be changed using Display 2. The cursor jumps over the NAME variable and positions itself at the beginning of the EMPLOYEE NUMBER variable. Figure 7 shows a completed Display 2. Figure 8 shows Display 3 with the protected fields and titles before any data is entered. Figure 9 shows a completed Display 3.

```
                        DISPLAY 1
  DEMONSTRATES DATA ENTRY/EDIT WITHOUT PROTECTED FIELDS
NAME :                        DATE OF BIRTH :
STREET ADDRESS :
CITY/STATE :
PHONE NUMBER :
OCCUPATION :
```

Figure 1. *Data entry without protected fields*

```
                        DISPLAY 2
    DEMONSTRATES DATA ENTRY/EDIT WITH PROTECTED FIELDS
                INCLUDING NUMERIC VALUES
NAME *                        EMPLOYEE NUMBER :     0
HIRE DATE :
SECTION NUMBER :    0
YEAR OF DEGREE :    0
SALARY :   0
```

Figure 2. *Data entry with protected fields*

```
                          DISPLAY 3
DEMONSTRATES FORMATTED SCREEN WITH EXTRA COMMENTS/TITLES
                        PERSONAL DATA
NAME*                                      PHONE NUMBER*
ADDRESS*
                                  RECREATIONAL DATA
HOBBIES  NUMBER 1:
         NUMBER 2:
SKILLS   NUMBER 1:
         NUMBER 2:
```

Figure 3. *Formatted screen with additional data*

```
                        DISPLAY 1
  DEMONSTRATES DATA ENTRY/EDIT WITHOUT PROTECTED FIELDS
NAME: JOHN Q. PUBLIC          DATE OF BIRTH: 7/4/1954
STREET ADDRESS :
CITY/STATE :
PHONE NUMBER :
OCCUPATION:
```

Figure 4. *Data entry without protected fields*

DISPLAY 1
DEMONSTRATES DATA ENTRY/EDIT WITHOUT PROTECTED FIELDS
NAME: JOHN Q. PUBLIC DATE OF BIRTH: 7/4/1954
STREET ADDRESS: 100 ANYSTREET
CITY/STATE: ANYTOWN, USA 00000
PHONE NUMBER: 555-1212
OCCUPATION: COMPUTER PROGRAMMER

Figure 5. *Screen display showing complete data entry*

DISPLAY 2
DEMONSTRATES DATA ENTRY/EDIT WITH PROTECTED FIELDS
INCLUDING NUMERIC VALUES
NAME* JOHN Q. PUBLIC EMPLOYEE NUMBER: 0
HIRE DATE:
SECTION NUMBER: 0
YEAR OF DEGREE: 0
SALARY: 0

Figure 6. *Data entry with protected fields*

DISPLAY 2
DEMONSTRATES DATA ENTRY/EDIT WITH PROTECTED FIELDS
INCLUDING NUMERIC VALUES
NAME* JOHN Q. PUBLIC EMPLOYEE NUMBER: 10000
HIRE DATE: 6/26/75
SECTION NUMBER: 1234
YEAR OF DEGREE: 1974
SALARY: 23000

Figure 7. *Display showing complete data entry*

DISPLAY 3
DEMONSTRATES FORMATTED SCREEN WITH EXTRA COMMENTS/TITLES
PERSONAL DATA
NAME* JOHN Q. PUBLIC PHONE NUMBER* 555-1212
ADDRESS* 100 ANYSTREET
ANYTOWN, USA 00000
RECREATIONAL DATA
HOBBIES NUMBER 1:
NUMBER 2:
SKILLS NUMBER 1
NUMBER 2

Figure 8. *Formatted screen with additional data*

DISPLAY 3
DEMONSTRATES FORMATTED SCREEN WITH EXTRA COMMENTS/TITLES
PERSONAL DATA
NAME* JOHN Q. PUBLIC PHONE NUMBER* 555-1212
ADDRESS* 100 ANYSTREET

Figure continued

	RECREATIONAL DATA
HOBBIES	NUMBER 1: COMPUTER HOBBYIST
	NUMBER 2: FLYING AIRPLANES
SKILLS	NUMBER 1: 45 WPM TYPIST
	NUMBER 2: ELEC MAINTENANCE

Figure 9. *Display showing complete data entry*

Assembly-Language Program Description

The assembly-language part of the program is discussed here in symbolic language format to show how it works. The assembled program has been converted to decimal values and is POKEd into memory by the subroutine at line 50000 in the BASIC program. The principal variables in this program are as follows:

NUM — The number of changeable variables on the screen as POKEd into memory by the BASIC program. NUM corresponds to the BASIC variable N.

LEN — A series of numbers representing the lengths of the variables which are also POKEd into memory by the BASIC program. These correspond to the L(1) through L(N) BASIC variables.

VARWK — Tracks which variable is being entered. The range is 1 to N, with N less than or equal to 32.

POS — Variable indicating position of cursor within the variable being worked. The range is 0 to LEN.

PTR — An address POKEd into memory by the BASIC program which points to the address in RAM containing the pointer to the 3-byte description of the A$(1) variable. The BASIC program derives this address using the VARPTR(A$(1)) command.

In the assembly-language program, lines 170–330 set up the initial register variables and position the cursor at the beginning of the first variable. The INPUT routine, lines 370–540, attempts to get a character from the keyboard. If no key has been pressed, the subroutine generates a block cursor, delays, restores the character to the screen, and then tries again to get a character from the keyboard. This process creates a flashing cursor on the video screen. Once the routine finds a character, control branches to the UPARR routine at line 580.

The first two lines of the UPARR routine check to see if the input character is an up arrow. If it is not an up arrow, control branches to the RTARR routine at line 810. If it is an up arrow, the routine checks to see if the variable being worked is the first variable on the screen. If so, control is returned to the INPUT routine with no further action. If the variable is not the first, the screen is searched backward, and the cursor is placed over the first position of the previous variable. The routine then passes control back to the INPUT routine.

The first two lines of the RTARR routine check to see if the input character is a right arrow. If the character is not a right arrow, the routine jumps to the LTARR routine at line 950, otherwise, a check is made to see if the cursor is at the last allowable position of the variable. If it is, control is passed to INPUT with no changes made. If the cursor is not at the last position, it moves forward one character space on the screen. Control is then passed to the INPUT routine.

The first two lines of the LTARR routine check to see if the input character is a left arrow. If the character is not a left arrow, control is passed to the DNARR routine at line 1070. If the character is a left arrow, a check is made to see if the cursor is in the first position of the variable. If it is, control is passed to INPUT with no changes made. If the cursor is not in the first position, the cursor is backed up one character space on the screen. Control is then passed to the INPUT routine.

The first two lines of the DNARR routine check to see if the input character is a down arrow. If it is not a down arrow, control is passed to the CARRET routine at line 1270. If the character is a down arrow, a check is made to see if the last variable on the screen is being processed. If so, control is returned to the INPUT routine with no changes. If not, the cursor is moved down to the first position of the next variable. Control is then passed to the INPUT routine.

The first two lines of the CARRET routine check to see if the input character is a carriage return. If the character is not a carriage return, control is passed to the EQUAL routine at line 1530. If it is a carriage return, a check is made to see if the cursor was in the first position of the variable. If so, control is passed to the DNARR routine, and the character is handled as a down arrow. If not, the number of blanks required to fill the remaining portion of the variable is calculated, and the remaining portion of the variable is filled with blanks. A check is then made to determine if the last variable on the screen was being processed when the key was pressed. If not, control is passed to the DNARR routine to move the cursor forward one variable. If so, control is passed to BEGIN, where the cursor is placed at position 0 of the first variable.

The first two lines of the EQUAL routine check to see if an equal sign was received. If not, control is passed to the CHAR routine at line 1820. If the character is an equal sign, the VARWK variable is set to 1 and the index register IX is loaded with the address of the BASIC pointer to the 3-byte description of the A$(1) variable in RAM. The cursor is then placed over position 0 of the first variable on the screen. The A$(1) pointer consists of three values: the length, the lower address, and the upper address of A$(1). First, B is loaded with the length, and DE is loaded with the address. The variable is then moved from the screen to the memory designated by the BASIC pointer to hold A$(1). This process continues for the other variables on the screen until the last variable is completed.

Control is then passed back to the BASIC program through the Z80 RET instruction.

The CHAR routine first checks to see if the cursor is at the last position of the variable. If so, control is then returned to the INPUT routine with no changes. If the cursor is not at the last position of the variable, the character is printed on the video screen and control returns to the INPUT routine.

Lines 1970-2010 allocate memory for the variables used by the assembly-language program.

BASIC Program Description

The BASIC portions of the form fillout program (Program Listing 2) are located in subroutines 50000 and 60000 in the demonstration program. The subroutine at 50000 loads the assembly-language portion of the program into high memory. The assembly-language routine, in decimal values, is located in lines 50090-50420. The data in the demonstration program is for a 48K disk configuration. The subroutine at 50000 need only be run once at the beginning of the BASIC program.

The subroutine at 60000 takes two types of variables from the BASIC program and stores them in appropriate memory locations for use by the assembly-language program. N represents the total number of variables on the display. L(1) through L(N) indicate the allowable lengths of the N variables. The subroutine then expands the A$(I) variables to the maximum lengths with line 60080 and derives the BASIC pointer to the A$(1) 3-byte description with the VARPTR command in line 60090. This decimal value is converted to a high and low memory address by lines 60110-60120 and POKEd into memory by line 60130. The assembly-language program is then called with the USR command in line 60140. Lines 60040 and 60150 save the variables used by the subroutine and restore these variables before exiting the subroutine. The only variables not available to the programmer are A$(I), L(I), N, A1, A2, A3, A4, A5, and A6. As a programming aid, the subroutine also checks to see that no more than 32 variables have been used. If this condition is not met, the program halts at that point.

Lines 100-230 set up the initial menu and load the assembly-language routine with a GOSUB 50000. Subroutine 1000 sets up the first display. Lines 1010-1100 print the display on the CRT. Line 1110 sets the number of variables to six and sets their lengths. The GOSUB 60000 sets up the assembly-language variables and calls the USR routine. Line 1130 converts the A$(I) variables returned into the appropriate program string variables.

The subroutine at 2000 is similar to the subroutine at 1000 with a few differences. Line 2060 prints the NAME on the screen but uses an asterisk delimiter to separate the prompt from the variable. The display con-

tains numeric variables in addition to string variables. Line 2140 converts the ASCII strings returned into numeric variables where appropriate and converts the remaining strings into the program string variables.

The subroutine at 3000 illustrates another way to use the form fillout program. In this subroutine, the display is set up to include titles as well as prompts and protected variables. These demonstrate how the program ignores any data on the screen except the variables preceded by a colon and two blank spaces.

Conversion to 16K/32K

To convert the BASIC subroutines to run on a 16K or 32K TRS-80 with or without disks, the following lines must be substituted for the corresponding lines in the subroutines. For the 16K version, you must set memory size to 32449 before entering BASIC. For the 32K version, set memory size to 48833. Substitute the following lines for the 16K version:

```
50010  Z=32450
50090  DATA 221, 33, 255, 127, 253, 33, 254, 127, 17, 222, 127
50240  DATA 58, 221, 127
50300  DATA 58, 221, 127
50330  DATA 221, 42, 219, 127
50370  DATA 58, 221, 127
60050  Z=32450
```

Substitute the following lines for the 32K version:

```
50010  Z= -16702
50090  DATA 221, 33, 255, 191, 253, 33, 254, 191, 17, 222, 191
50240  DATA 58, 221, 191
50300  DATA 58, 221, 191
50330  DATA 221, 42, 219, 191
50370  DATA 58, 221, 191
60050  Z= -16702
```

Without Disk

To use this program without disks, the only additional changes are in lines 50030 and 60140. Be sure that you have changed the necessary lines if the memory size has been changed. In a 16K non-disk configuration, change these lines to read:

```
50030 POKE 16526, 194: POKE 16527, 126
60140 X=USR(X)
```

In a 32K, non-disk configuration, change these lines to read:

```
50030 POKE 16526, 194: POKE 16527, 190
60140 X=USR(X)
```

In a 48K, non-disk configuration, change these lines to read:

```
50030 POKE 16526, 194: POKE 16527, 254
60140 X=USR(X)
```

Program Listing 1.

Assembly-language program loaded by the subroutine at 50000 in the demonstration BASIC program

```
               ØØ1ØØ          ;ASSEMBLY LANGUAGE PORTION OF FORM-FILLOUT
               ØØ11Ø          ;WRITTEN BY  :  GARY LINDSEY
               ØØ12Ø          ;                1Ø41 NOGALES AVENUE
               ØØ13Ø          ;                PALM BAY, FLORIDA 329Ø5
               ØØ14Ø ;
               ØØ15Ø ;=================================================
               ØØ16Ø ;
FEC2           ØØ17Ø          ORG     ØFEC2H          ;SETS LOCATION OF PGM
FEC2 DD21FFFF  ØØ18Ø          LD      IX,POS          ;IX POINTS TO POSITION
FEC6 FD21FEFF  ØØ19Ø          LD      IY,VARWK        ;IY POINTS TO VARWK
               ØØ2ØØ ;
               ØØ21Ø ;=================================================
               ØØ22Ø ;
FECA 11DEFF    ØØ23Ø BEGIN    LD      DE,LEN          ;DE POINTS TO LEN OF VARWK
FECD 21FF3B    ØØ24Ø          LD      HL,3BFFH        ;HL= TOP OF VIDEO MEM-1
FEDØ 23        ØØ25Ø INC1     INC     HL              ;HL=TOP OF VIDEO MEM
FED1 7E        ØØ26Ø          LD      A,(HL)          ;LOAD A WITH VIDEO CHAR
FED2 FE3A      ØØ27Ø          CP      ':'             ;CHECK IF A IS COLON
FED4 2ØFA      ØØ28Ø          JR      NZ,INC1         ;IF NOT COLON JP TO INC1
FED6 23        ØØ29Ø          INC     HL              ;INCREMENT VIDEO POINTER
FED7 23        ØØ3ØØ          INC     HL              ;TO POS Ø OF VARIABLE
FED8 23        ØØ31Ø          INC     HL              ;AFTER THE COLON
FED9 FD36ØØØ1  ØØ32Ø          LD      (IY),1          ;SETS VARWK TO 1
FEDD DD36ØØØØ  ØØ33Ø          LD      (IX),Ø          ;SET POS TO Ø
               ØØ34Ø ;
               ØØ35Ø ;=================================================
               ØØ36Ø ;
FEE1 D5        ØØ37Ø INPUT    PUSH    DE              ;SAVE LEN POINTER
FEE2 FDE5      ØØ38Ø          PUSH    IY              ;SAVE VARWK POINTER
FEE4 CD2BØØ    ØØ39Ø          CALL    ØØ2BH           ;CALL SCAN KEYBOARD S/R
FEE7 B7        ØØ4ØØ          OR      A               ;OR A
FEE8 FDE1      ØØ41Ø          POP     IY              ;RESTORE VARWK POINTER
FEEA D1        ØØ42Ø          POP     DE              ;RESTORE LEN POINTER
FEEB 2Ø15      ØØ43Ø          JR      NZ,UPARR        ;IF A NOT Ø JP TO UPARR
FEED 4E        ØØ44Ø          LD      C,(HL)          ;SAVE CHAR IN C
FEEE 3E8F      ØØ45Ø          LD      A,143           ;LOAD A WITH CURSOR CHAR
FEFØ 77        ØØ46Ø          LD      (HL),A          ;PUT CURSOR ON SCREEN
FEF1 C5        ØØ47Ø          PUSH    BC              ;SAVE BC WHICH HOLDS CHAR
FEF2 Ø1EAØØ    ØØ48Ø          LD      BC,ØEAH         ;LOAD BC WITH DELAY COUNT
FEF5 CD6ØØØ    ØØ49Ø          CALL    ØØ6ØH           ;CALL DELAY ROUTINE
FEF8 C1        ØØ5ØØ          POP     BC              ;RESTORE BC
FEF9 71        ØØ51Ø          LD      (HL),C          ;PUT CHAR ON SCREEN
FEFA Ø1FØØØ    ØØ52Ø          LD      BC,ØFØH         ;LOAD BC WITH DELAY COUNT
FEFD CD6ØØØ    ØØ53Ø          CALL    ØØ6ØH           ;CALL DELAY ROUTINE
FFØØ 18DF      ØØ54Ø          JR      INPUT           ;JUMP TO INPUT
               ØØ55Ø ;
               ØØ56Ø ;=================================================
               ØØ57Ø ;
FFØ2 FE5B      ØØ58Ø UPARR    CP      5BH             ;CHECK IF A IS UP ARROW
FFØ4 2Ø2Ø      ØØ59Ø          JR      NZ,RTARR        ;IF NOT JUMP TO RTARR
FFØ6 FD7EØØ    ØØ6ØØ          LD      A,(IY)          ;LD A WITH VARWK
FFØ9 FEØ1      ØØ61Ø          CP      1               ;CHECK IF FIRST VARIABLE
FFØB 28D4      ØØ62Ø          JR      Z,INPUT         ;IF TRUE JP TO INPUT
FFØD 2B        ØØ63Ø DEC1     DEC     HL              ;DECREMENT VIDEO POINTER
FFØE 7E        ØØ64Ø          LD      A,(HL)          ;LOAD A WITH VIDEO CHAR
FFØF FE3A      ØØ65Ø          CP      ':'             ;CHECK IF COLON
FF11 2ØFA      ØØ66Ø          JR      NZ,DEC1         ;IF NOT COLON JP TO DEC1
```

Program continued

```
FF13 2B       ØØ67Ø DEC2    DEC   HL          ;DECREMENT VIDEO POINTER
FF14 7E       ØØ68Ø         LD    A,(HL)      ;LOAD A WITH VIDEO CHAR
FF15 FE3A     ØØ69Ø         CP    ':'         ;CHECK IF COLON
FF17 2ØFA     ØØ7ØØ         JR    NZ,DEC2     ;IF NOT COLON JP TO DEC2
FF19 23       ØØ71Ø         INC   HL          ;INCREMENT VIDEO POINTER
FF1A 23       ØØ72Ø         INC   HL          ;TO POS Ø OF VARIABLE
FF1B 23       ØØ73Ø         INC   HL          ;AFTER COLON
FF1C FD35ØØ   ØØ74Ø         DEC   (IY)        ;DECREMENTS VARWK
FF1F DD36ØØØØ ØØ75Ø         LD    (IX),Ø      ;SET POS TO Ø
FF23 1B       ØØ76Ø         DEC   DE          ;DE NOW POINTS TO NEW LEN
FF24 18BB     ØØ77Ø         JR    INPUT       ;JUMP TO INPUT
              ØØ78Ø ;
              ØØ79Ø ;==========================================================
              ØØ8ØØ ;
FF26 FEØ9     ØØ81Ø RTARR   CP    Ø9H         ;CHECK IF A IS RT ARROW
FF28 2ØØF     ØØ82Ø         JR    NZ,LTARR    ;IF NOT JUMP TO LTARR
FF2A 1A       ØØ83Ø         LD    A,(DE)      ;LD A WITH LENGTH OF VAR
FF2B DD46ØØ   ØØ84Ø         LD    B,(IX)      ;LD B WITH POSITION
FF2E B8       ØØ85Ø         CP    B           ;COMPARE LEN WITH POS
FF2F 28BØ     ØØ86Ø         JR    Z,INPUT     ;IF POS=LEN THEN INPUT
FF31 23       ØØ87Ø         INC   HL          ;INCREMENT VIDEO POINTER
FF32 DD34ØØ   ØØ88Ø         INC   (IX)        ;INCREMENTS POS
FF35 18AA     ØØ89Ø         JR    INPUT       ;JUMP TO INPUT
              ØØ9ØØ ;
FF37 1891     ØØ91Ø XFER1   JR    BEGIN       ;JUMP TO BEGIN
              ØØ92Ø ;
              ØØ93Ø ;==========================================================
              ØØ94Ø ;
FF39 FEØ8     ØØ95Ø LTARR   CP    Ø8H         ;CHECK IF A IS LT ARROW
FF3B 2ØØE     ØØ96Ø         JR    NZ,DNARR    ;IF NOT JP TO DNARR
FF3D 3EØØ     ØØ97Ø         LD    A,Ø         ;LOAD A WITH Ø
FF3F DD46ØØ   ØØ98Ø         LD    B,(IX)      ;LOAD B WITH POS
FF42 B8       ØØ99Ø         CP    B           ;COMPARE POS WITH Ø
FF43 289C     Ø1ØØØ         JR    Z,INPUT     ;IF POS=Ø THEN INPUT
FF45 2B       Ø1Ø1Ø         DEC   HL          ;DECRMENT VIDEO POINTER
FF46 DD35ØØ   Ø1Ø2Ø         DEC   (IX)        ;DECREMENTS POS
FF49 1896     Ø1Ø3Ø XFER2   JR    INPUT       ;JUMP TO INPUT
              Ø1Ø4Ø ;
              Ø1Ø5Ø ;==========================================================
              Ø1Ø6Ø ;
FF4B FEØA     Ø1Ø7Ø DNARR   CP    ØAH         ;CHECK IF A IS DNARR
FF4D 2Ø1C     Ø1Ø8Ø         JR    NZ,CARRET   ;IF NOT JP TO CARRET
FF4F FD46ØØ   Ø1Ø9Ø DNARR1  LD    B,(IY)      ;LOAD B WITH VARWK
FF52 3ADDFF   Ø11ØØ         LD    A,(NUM)     ;LOAD A WITH NUM
FF55 B8       Ø111Ø         CP    B           ;COMPAR VARWK WITH NUM
FF56 2889     Ø112Ø         JR    Z,INPUT     ;IF VARWK=NUM THEN INPUT
FF58 23       Ø113Ø INC2    INC   HL          ;INCREMENT VIDEO POINTER
FF59 7E       Ø114Ø         LD    A,(HL)      ;LOAD A WITH VIDEO CHAR
FF5A FE3A     Ø115Ø         CP    ':'         ;CHECK IF COLON
FF5C 2ØFA     Ø116Ø         JR    NZ,INC2     ;IF NOT COLON JP TO INC2
FF5E 23       Ø117Ø         INC   HL          ;INCREMENT VIDEO POINTER
FF5F 23       Ø118Ø         INC   HL          ;TO POS Ø OF VARIABLE
FF6Ø 23       Ø119Ø         INC   HL          ;AFTER COLON
FF61 DD36ØØØØ Ø12ØØ         LD    (IX),Ø      ;LOAD POS WITH ZERO
FF65 13       Ø121Ø         INC   DE          ;DE POINTS AT NEW LEN
FF66 FD34ØØ   Ø122Ø         INC   (IY)        ;INCREMENTS VARWK
FF69 18DE     Ø123Ø         JR    XFER2       ;JP TO INPUT VIA XFER2
              Ø124Ø ;
              Ø125Ø ;==========================================================
              Ø126Ø ;
FF6B FEØD     Ø127Ø CARRET  CP    ØDH         ;CHECK IF A IS CAR RET
```

```
FF6D 2021       Ø128Ø          JR    NZ,EQUAL      ;IF NOT JUMP TO EQUAL
FF6F DD7EØØ     Ø129Ø          LD    A,(IX)        ;LOAD A WITH POSITION
FF72 FEØØ       Ø13ØØ          CP    Ø             ;COMPARE POS TO ZERO
FF74 28D9       Ø131Ø          JR    Z,DNARR1      ;IF POS=Ø THEN DNARR1
FF76 47         Ø132Ø          LD    B,A           ;LOAD B WITH POS
FF77 AF         Ø133Ø          XOR   A             ;ZERO A REGISTER
FF78 1A         Ø134Ø          LD    A,(DE)        ;LOAD A WITH LENGTH
FF79 9Ø         Ø135Ø          SUB   B             ;A= # OF BLANKS TO END
FF7A 3C         Ø136Ø          INC   A             ;ADD ONE TO BLANKS
FF7B 2B         Ø137Ø          DEC   HL            ;DECREMENT VIDEO POINTER
FF7C Ø62Ø       Ø138Ø          LD    B,2ØH         ;LOAD B WITH BLANK CHAR
FF7E 23         Ø139Ø CR1      INC   HL            ;INCREMENT VIDEO POINTER
FF7F 7Ø         Ø14ØØ          LD    (HL),B        ;WRITE BLANK TO SCREEN;
FF8Ø 3D         Ø141Ø          DEC   A             ;DECEREMENT # OF BLANKS
FF81 2ØFB       Ø142Ø          JR    NZ,CR1        ;IF BLANKS<>Ø THEN CR1
FF83 FD46ØØ     Ø143Ø          LD    B,(IY)        ;LOAD B WITH VARWK
FF86 3ADDFF     Ø144Ø          LD    A,(NUM)       ;LOAD A WITH NUM
FF89 B8         Ø145Ø          CP    B             ;COMPARE VARWK WITH NUM
FF8A 2ØC3       Ø146Ø          JR    NZ,DNARR1     ;IF VARWK<>NUM THEN DNARR1
FF8C 18A9       Ø147Ø          JR    XFER1         ;JUMP TO BEGIN VIA XFER1
                Ø148Ø ;
FF8E 18B9       Ø149Ø XFER3    JR    XFER2         ;RELATIVE JP XFER INST
                Ø15ØØ ;
                Ø151Ø ;===================================================
                Ø152Ø ;
FF9Ø FE3D       Ø153Ø EQUAL    CP    '='           ;CHECK IF A IS EQUAL
FF92 2Ø34       Ø154Ø          JR    NZ,CHAR       ;IF NOT JP TO CHAR
FF94 FD36ØØØ1   Ø155Ø          LD    (IY),1        ;SET VARWK TO 1
FF98 DD2ADBFF   Ø156Ø          LD    IX,(PTR)      ;IX=PTR TO BASIC STR PTR
FF9C 21FF3B     Ø157Ø          LD    HL,3BFFH      ;HL=TOP OF VIDEO MEM-1
FF9F 23         Ø158Ø INC3     INC   HL            ;HL=TOP OF VIDEO MEM
FFAØ 7E         Ø159Ø          LD    A,(HL)        ;LOAD A WITH CHARACTER
FFA1 FE3A       Ø16ØØ          CP    ':'           ;CHECK IF COLON
FFA3 2ØFA       Ø161Ø          JR    NZ,INC3       ;IF NOT JP TO INC3
FFA5 23         Ø162Ø          INC   HL            ;INCREMENT VIDEO POINTER
FFA6 23         Ø163Ø          INC   HL            ;TO POS Ø OF VARIABLE
FFA7 23         Ø164Ø          INC   HL            ;AFTER COLON
FFA8 DD4EØØ     Ø165Ø          LD    C,(IX)        ;C LOADED WITH BASIC LEN
FFAB Ø6ØØ       Ø166Ø          LD    B,Ø           ;B=Ø
FFAD DD23       Ø167Ø          INC   IX            ;IX= PTR TO LO VAR ADDRESS
FFAF DD5EØØ     Ø168Ø          LD    E,(IX)        ;E = LO ADDRESS OF VAR
FFB2 DD23       Ø169Ø          INC   IX            ;IX= PTR TO HI VAR ADDRESS
FFB4 DD56ØØ     Ø17ØØ          LD    D,(IX)        ;D = HI ADDRESS OF VAR
FFB7 EDBØ       Ø171Ø          LDIR                ;MOVE VIDEO TO VAR MEM
FFB9 3ADDFF     Ø172Ø          LD    A,(NUM)       ;A=TOTAL # OF VARIABLES
FFBC FD46ØØ     Ø173Ø          LD    B,(IY)        ;B=VAR WORKED
FFBF B8         Ø174Ø          CP    B             ;CHECK IF LAST VARIABLE
FFCØ C8         Ø175Ø          RET   Z             ;RET TO BASIC IF LAST
FFC1 FD34ØØ     Ø176Ø          INC   (IY)          ;INCREMENT VARWK
FFC4 DD23       Ø177Ø          INC   IX            ;PTR TO NEXT A$ VARIABLE
FFC6 18D7       Ø178Ø          JR    INC3          ;START NEXT VARIABLE
                Ø179Ø ;
                Ø18ØØ ;===================================================
                Ø181Ø ;
FFC8 F5         Ø182Ø CHAR     PUSH  AF            ;SAVE CHARACTER IN AF
FFC9 DD46ØØ     Ø183Ø          LD    B,(IX)        ;LOAD B WITH POS
FFCC 1A         Ø184Ø          LD    A,(DE)        ;LOAD A WITH LEN
FFCD B8         Ø185Ø          CP    B             ;COMPARE LEN WITH POS
FFCE 2ØØ3       Ø186Ø          JR    NZ,START1     ;IF LEN<>POS JP TO START1
FFDØ F1         Ø187Ø          POP   AF            ;RESTORE CHAR IN AF
FFD1 18BB       Ø188Ø          JR    XFER3         ;JUMP TO INPUT VIA XFER3
```

Program continued

```
FFD3 F1        01890 START1  POP    AF          ;RESTORE CHAR IN AF
FFD4 77        01900         LD     (HL),A      ;PUT CHAR ON SCREEN
FFD5 DD3400    01910         INC    (IX)        ;INCREMENT POS
FFD8 23        01920         INC    HL          ;INCREMENT VIDEO POINTER
FFD9 18B3      01930         JR     XFER3       ;JUMP TO INPUT VIA XFER3
               01940 ;
               01950 ;=====================================================
               01960 ;
FFDB 0000      01970 PTR     DEFW   0           ;PTR TO BASIC VAR PTR
FFDD 00        01980 NUM     DEFB   0           ;NUMBER OF VARIABLES
0020           01990 LEN     DEFS   32          ;UP TO 32 VAR LENGTHS
FFFE 00        02000 VARWK   DEFB   0           ;# OF VAR BEING WORKED
FFFF 00        02010 POS     DEFB   0           ;INDICATES POS WITHIN VAR
0000           02020         END                ;END OF ASSY LANGUAGE PGM
00000 TOTAL ERRORS
```

Program Listing 2.

Demonstration BASIC program illustrating the use of the subroutines at 50000 and 60000 to implement the form fillout technique

```
10 REM
20 REM
30 REM   DEMONSTRATION OF FORM-FILLOUT PROGRAM
40 REM   WRITTEN BY:  GARY S. LINDSEY
50 REM                1041 NOGALES AVENUE
60 REM                PALM BAY, FLORIDA 32905
70 REM
80 REM=================================================
90 REM
100 CLEAR 500
110 DIM A(32),A$(32),L(32)
120 GOSUB 50000
130 CLS
140 PRINT TAB(20) "FORM FILLOUT DEMONSTRATION"
150 PRINT
160 PRINT TAB(10) "1 - PROCESS PERSONAL DATA"
170 PRINT TAB(10) "2 - PROCESS WORK HISTORY DATA"
180 PRINT TAB(10) "3 - PROCESS RECREATIONAL DATA"
190 PRINT
200 INPUT "ENTER YOUR CHOICE:  ";C
210 IF C<1 OR C>3 THEN 130
220 ON C GOSUB 1000,2000,3000
230 GOTO 130
240 REM
250 REM=================================================
260 REM
1000 REM FIRST SCREEN FOR DEMONSTRATION OF FORM FILLOUT
1010 CLS
1020 PRINT TAB(25) "DISPLAY 1"
1030 PRINT "  DEMONSTRATES DATA ENTRY/EDIT WITHOUT PROTECTED FIE
LDS"
1040 PRINT
1050 PRINT "NAME:  ";N$;TAB(30);"DATE OF BIRTH:  ";B$
1060 PRINT "STREET ADDRESS   :  ";AD$
1070 PRINT "CITY/STATE       :  ";C$
1080 PRINT "PHONE NUMBER     :  ";P$
1090 PRINT
```

```
11ØØ PRINT "OCCUPATION:  ";O$
111Ø N=6:L(1)=2Ø:L(2)=12:L(3)=3Ø:L(4)=3Ø:L(5)=15:L(6)=3Ø
112Ø GOSUB 6ØØØØ
113Ø N$=A$(1):B$=A$(2):AD$=A$(3):C$=A$(4):P$=A$(5):O$=A$(6)
114Ø RETURN
115Ø REM
116Ø REM=================================================
117Ø REM
2ØØØ REM SECOND SCREEN FOR DEMONSTRATION OF FORM FILLOUT
2Ø1Ø CLS
2Ø2Ø PRINT TAB(25) "DISPLAY 2"
2Ø3Ø PRINT TAB(5)"DEMONSTRATES DATA ENTRY/EDIT WITH PROTECTED FI
ELDS"
2Ø4Ø PRINT TAB(5)"              INCLUDING NUMERIC VALUES"
2Ø5Ø PRINT
2Ø6Ø PRINT "NAME *  ";N$;TAB(3Ø);"EMPLOYEE NUMBER:  ";E
2Ø7Ø PRINT
2Ø8Ø PRINT "HIRE DATE:  ";HD$
2Ø9Ø PRINT "SECTION NUMBER:  ";S
21ØØ PRINT "YEAR OF DEGREE:  ";Y
211Ø PRINT "SALARY:  ";SA
212Ø N=5:L(1)=6:L(2)=1Ø:L(3)=5:L(4)=5:L(5)=6
213Ø GOSUB 6ØØØØ
214Ø E=VAL(A$(1)):HD$=A$(2):S=VAL(A$(3)):Y=VAL(A$(4)):SA=VAL(A$(
5))
215Ø RETURN
216Ø REM
217Ø REM=================================================
218Ø REM
3ØØØ REM THIRD SCREEN FOR DEMONSTRATION OF FORM-FILLOUT
3Ø1Ø CLS
3Ø2Ø PRINT TAB(25) "DISPLAY 3"
3Ø3Ø PRINT  " DEMONSTRATES FORMATTED SCREEN WITH EXTRA COMMENTS/
TITLES"
3Ø4Ø PRINT TAB(2Ø) "PERSONAL DATA"
3Ø5Ø PRINT
3Ø6Ø PRINT "NAME*  ";N$;TAB(3Ø);"PHONE NUMBER*  ";P$
3Ø7Ø PRINT "ADDRESS*";TAB(1Ø);AD$
3Ø8Ø PRINT TAB(1Ø);C$
3Ø9Ø PRINT
31ØØ PRINT TAB(2Ø) "RECREATIONAL DATA"
311Ø PRINT
312Ø PRINT "HOBBIES";TAB(1Ø);"NUMBER 1:  ";H1$
313Ø PRINT TAB(1Ø)"NUMBER 2:  ";H2$
314Ø PRINT "SKILLS";TAB(1Ø)"NUMBER 1:  ";S1$
315Ø PRINT TAB(1Ø)"NUMBER 2:  ";S2$
316Ø N=4:L(1)=2Ø:L(2)=2Ø:L(3)=2Ø:L(4)=2Ø
317Ø GOSUB 6ØØØØ
318Ø H1$=A$(1):H2$=A$(2):S1$=A$(3):S2$=A$(4)
319Ø RETURN
32ØØ REM
321Ø REM=================================================
322Ø REM
5ØØØØ REM SETS Z=BEGINNING OF USR PROGRAM
5ØØ1Ø Z=-318
5ØØ2Ø REM SETS USR PROGRAM ENTRY POINT
5ØØ3Ø DEFUSRØ=Z
5ØØ4Ø REM POKES USR ASSEMBLY LANGUAGE PROGRAM INTO MEMORY
5ØØ5Ø RESTORE:FOR I=Z TO Z+28Ø
5ØØ6Ø READ X:POKE I,X
5ØØ7Ø NEXT I
```

Program continued

```
50080 RETURN
50090 DATA 221, 33, 255, 255, 253, 33, 254, 255, 17, 222, 255
50100 DATA 33, 255, 59, 35, 126, 254, 58, 32, 250, 35
50110 DATA 35, 35, 253, 54, 0, 1, 221, 54, 0, 0
50120 DATA 213, 253, 229, 205, 43, 0, 183, 253, 225, 209
50130 DATA 32, 21, 78, 62, 143, 119, 197, 1, 234, 0
50140 DATA 205, 96, 0, 193, 113, 1, 240, 0, 205, 96, 0
50150 DATA 24, 223, 254, 91, 32, 32, 253, 126, 0, 254, 1
50160 DATA 40, 212, 43, 126
50170 DATA 254, 58, 32, 250, 43, 126, 254, 58, 32, 250
50180 DATA 35, 35, 35, 253, 53, 0, 221, 54, 0, 0
50190 DATA 27, 24, 187, 254, 9, 32, 15, 26
50200 DATA 221, 70, 0, 184, 40, 176, 35, 221, 52, 0
50210 DATA 24, 170, 24, 145, 254, 8, 32, 14, 62, 0
50220 DATA 221, 70, 0, 184, 40, 156, 43, 221, 53, 0
50230 DATA 24, 150, 254, 10, 32, 28, 253, 70, 0
50240 DATA 58, 221, 255
50250 DATA 184, 40, 137, 35, 126, 254, 58, 32, 250, 35
50260 DATA 35, 35, 221, 54, 0, 0, 19, 253, 52, 0
50270 DATA 24, 222, 254, 13, 32, 33, 221, 126, 0
50280 DATA 254, 0, 40, 217, 71, 175, 26, 144, 60, 43
50290 DATA 6, 32, 35, 112, 61, 32, 251, 253, 70, 0
50300 DATA 58, 221, 255
50310 DATA 184, 32, 195, 24, 169, 24, 185
50320 DATA 254, 61, 32, 52, 253, 54, 0, 1
50330 DATA 221, 42, 219, 255
50340 DATA 33, 255, 59, 35, 126, 254, 58
50350 DATA 32, 250, 35, 35, 35, 221, 78, 0, 6, 0, 221, 35
50360 DATA 221, 94, 0, 221, 35, 221, 86, 0, 237, 176
50370 DATA 58, 221, 255
50380 DATA 253, 70, 0, 184, 200
50390 DATA 253, 52, 0, 221, 35, 24, 215
50400 DATA 245, 221, 70, 0
50410 DATA 26, 184, 32, 3, 241, 24, 187, 241, 119
50420 DATA 221, 52, 0, 35, 24, 179
50430 REM
50440 REM==================================================
50450 REM
60000 REM POKES NECESSARY NUMBER (N), LENGTHS (L(I)), AND
60010 REM THE POINTER TO A$(1) INTO MEMORY FOR USE BY
60020 REM THE ASSEMBLY LANGUAGE PORTION OF THE PROGRAM.
60030 IF N>32 THEN PRINT "TOO MANY VARIABLES":END
60040 A1=X:A2=I:A3=H:A4=L:A5=V:A6=Z
60050 Z=-318
60060 X=Z+283:POKE X,N:X=X+1
60070 FOR I=1 TO N:POKE X,L(I):X=X+1:NEXT I
60080 FOR I=1 TO N:A$(I)=STRING$(L(I)," "):NEXT I
60090 H=0:L=0:X=VARPTR(A$(1))
60100 IF X<0 THEN X=X+65536
60110 H=INT(X/256)
60120 L=X-H*256
60130 POKE Z+281,L:POKE Z+282,H
60140 X=USR0(X)
60150 X=A1:I=A2:H=A3:L=A4:V=A5:Z=A6
60160 RETURN
```

4

Idiosyncracies in Radio Shack's BASIC

by John Blommers

System Requirements:
Model I
Level II BASIC
or Disk BASIC
16K RAM

Radio Shack's Model I Disk BASIC has some bugs and idiosyncracies you should know. This chapter covers some of them, as well as ways to avoid numerical errors in solving problems.

The IF-THEN statement does not require the word THEN, provided there is no ambiguity in the statement. The following lines work properly:

```
100 A=1 : B=A : C=1 : D=2 : I=9 : J=I
110 IF A=B IF C<>D IF I=J PRINT "HELLO"
```

Since the three comparisons are all true, the word HELLO is printed.

When a comparison statement is executed, it results in a value which is either true (−1) or false (0). For example:

```
99  INPUT "Y,Z";Y,Z
100 X=Y=Z ' sets X to 0 if Y isn't equal to Z
101 PRINT X ' sets X to -1 if Y equals Z
102 GOTO 99
```

Compound statements work on a single line, but they also work with the IF-THEN-ELSE statement:

```
100 IF I=2 THEN A=B:C=D:E=F ELSE J=K:L=M:G=71
```

BASIC allows the user to define functions, usually at the beginning of the program. If a run-time error occurs as a result of a problem in the function definition statement, it is the statement calling the function—not the statement that defined it—that is flagged as the incorrect statement.

```
100 DEF FNA(X)=SQRT(X)
200 PRINT FNA(4)
```

This program causes a syntax error in line 200; however, the true error is in line 100 (the function for square root is SQR, not SQRT—that is the actual error).

To suppress the line feed in a PRINT statement, you place a semicolon after the last variable. This fails to work at location 1023, the last location on the screen.

```
100 PRINT @ 1023,"*";  ' still scrolls the screen.
```

BASIC occasionally interprets mathematically identical values differently. The numbers 3328D0 and 33.28D0*100D0 should be identical; however, the following statement results in a nonzero answer:

```
100 PRINT 3328D0-33.28D0*100D0
```

The result is -5.6843418860808002D-14. The multiplication produces a round-off error in the last digit of the double-precision answer.

Sometimes BASIC can be forced to misinterpret a statement.

```
110 X=1.D0 : Y=2.D0
120 PRINT X+0D-(Y+0D)  ' will print two numbers.
 1    2
```

The confusion arises because the double-precision number 0D should be written 0D0 to help BASIC continue with the arithmetic. Because it thinks that X+0 is one variable and the D-(Y+0D) is a second variable, it prints two numbers. It prints the numbers 3 and 2 for the following:

```
100 PRINT 1+2X+X
```

The following PRINT statement prints a -1:

```
100 PRINT 1=1
```

This happens because 1=1 is a true statement and, therefore, has the value -1 assigned to it.

The VAL function converts a string into a number only if the first character is plus, minus, or a digit from zero to nine. This causes the following, otherwise legal conversions to fail and return a zero value:

```
100 PRINT VAL("  -32")      ' leading blank
110 PRINT VAL("&HFF")       ' in DOS BASIC should give 255
120                         ' but gives 0 instead !!
```

Another bug in the VAL function is that it attempts to convert a long numeric string, even though the extra digits cannot contribute to the precision of the answer. The resulting calculations in BASIC cause an overflow or underflow, giving a run-time error. Consider the following:

```
99 CLEAR 100
100 PRINT VAL("."+STRING$(39,"7"))
```

This program results in an OV error when you use 39, but it works with 38. BASIC supports exponents from -38 to +38.

When typing in DATA statements, you may inadvertently omit a number, leading to unexpected results, because no error message is gen-

erated by BASIC to tell you it didn't see any data between the commas. The variable you were trying to READ into the program is set to zero when this happens. Consider the following program:

```
100 FOR I=1 TO 10 : READ A : PRINT A; : NEXT : END
110 DATA 1,2,3,,,6,7,8,9,10 ' 4TH & 5TH ARE MISSING
```

The result of this program is 1 2 3 0 0 6 7 8 9 10.

The word THEN need not be used in the IF-THEN-ELSE statement, as shown in the following program:

```
700 INPUT "ENTER A STRING ";A$
800 IF A$="2000" ELSE PRINT "NOT 2000"
900 IF A$="1000" PRINT "IT'S 1000" ELSE
                 PRINT "NOT 1000"
990 GO TO 700
```

Since BASIC stores real numbers using four bytes in binary notation, certain arithmetic operations give rise to tiny errors. For example:

```
100 A=20.01 : B=20 : PRINT A-B 'prints .0100002.
```

It is true that 20.01 – 20.00 = 0.01, but because BASIC retains only about seven to eight digits of precision, subtracting nearly equal real numbers results in a lot of garbage digits. This result is not peculiar to the TRS-80, but applies to many computers.

It is not generally known that the file input statement INPUT #1, variablelist can be expressed more generally as INPUT #N,variablelist, where N is –1 or –2 for cassette port 1 or 2. This can be used as follows:

```
100 INPUT "WHICH CASSETTE PORT (1 OR 2) ";N
110 IF N<>1 AND N<>2 THEN 100 ELSE N=-N
120 INPUT #N,A$
130 PRINT "THE DATA IS ***" A$ "****"
140 GO TO 100
```

In DOS BASIC, N is a positive number that refers to the number of the file buffer.

BASIC calculates X raised to the Y power internally by the formula EXP(Y*LOG(X)). It does so even if both X and Y are integers. Try raising 2 to the thirteenth power. The answer is 8192.01 instead of 8192. If you know in advance that the calculation should result in an integer, you can obtain the correct result by adding 0.5 to the calculation and using the FIX function to create an integer.

BASIC generally allows you to put spaces wherever you want, ignoring them unless they appear inside quotation marks. This is not true for the TAB function. The following program gives a SUBSCRIPT OUT OF RANGE message:

```
100 PRINT TAB (20) "HELLO" : END
```

This happens because the token for TAB function represents the characters TAB(, rather than the characters TAB. BASIC sees the TAB (20) and assumes that this function refers to the twentieth element of the array

TA. Since the default dimension of all arrays is 10, BASIC gives you an error message.

BASIC prints only six significant figures of a number, even if you use PRINT USING *"#.############"*, as shown in the following program:

```
100 X=1/3
110 Y=0.333333
120 PRINT X,Y
130 IF X=Y PRINT " X AND Y ARE EQUAL "
140 IF X<>Y PRINT "X AND Y ARE UNEQUAL"
```

This prints the following:

```
0.333333          0.333333
X AND Y ARE UNEQUAL
```

Only if Y=0.333 333 33 is entered will X and Y be considered equal by BASIC.

The built-in math functions, such as SIN(X), return single-precision results regardless of the precision of the argument X. If X is less than 100, the SIN function returns an answer correct to at least five decimal places. For X near 1,000,000, the SIN function returns about one digit of accuracy, but for X greater than 100,000,000, the value 0 is returned. The SIN of 1E7 wastes all seven significant digits in specifying the input angle. Here is a summary of results:

X (in radians)	SIN(X)	CORRECT RESULT (6-digit)
100	-0.506368	-0.506366
10 000	-0.30566	-0.305614
1 000 000	-0.382683	-0.349994
10 000 000	0.707107	0.420548
100 000 000	0	0.931639
11 000 000 000	0	0.0681113

The solution to this inaccuracy with the trigonometric functions is to recompute the argument in double precision by subtracting multiples of two times pi. The SIN of the remainder should be fairly accurate. For example, run the following program:

```
100 DEFDBL A-X                       ' variables double precision
110 PI=3.14159265358979323846        ' accurate, eh?
120 INPUT "X= ";X                    ' this is the argument
130 X1=X/(2.D0*PI)                   ' how many unit circles
140 XX=FIX(X1)                       ' # unit circles to remove
150 X2=X1-XX                         ' fraction of unit circle left
160 X3=X2*2.D0*PI                    ' reduced argument
170 Y=SIN(X3)                        ' accurate result desired
180 PRINT "SIN("X")="Y               ' ok. print answer!
190 GO TO 120                        ' let the human weary itself
```

Printing out the intermediate values X1,XX,X2, and X3 lets the programmer see what is happening at each stage.

The SQR function, while accurate to seven digits, may not return the exact answer. The following program line prints out the word INEXACT if the answer isn't exact:

```
100 IF 5=SQR(25) PRINT "EXACT" ELSE
                 PRINT "INEXACT"
```

There are many perfect squares for which the SQR function gives an inexact result. However, a simple formula based on Newton's Method makes the square root exact, as shown in line 140 below:

```
110 INPUT "ENTER A NUMBER "; N
120 X=SQR(N)
130 PRINT "FIRST ESTIMATE IS REALLY" CDBL(X)
140 Z=(X+N/X)/2  ' one Newton iteration
150 PRINT "SECOND ESTIMATE IS REALLY" CDBL(Z)
160 GO TO 110
```

PRINT SQR(25) prints out a 5 because the TRS-80 shows only six digits.

Other numerical oddities:

```
PRINT    100000+1        prints 100001
PRINT   1000000+1        prints 1E+06
PRINT  10000000+1        prints 10000001
```

But

```
PRINT CDBL(   100000+1)  prints    100001
PRINT CDBL(  1000000+1)  prints   1000001
PRINT CDBL(10000000+1)   prints 10000001
```

The TRS-80 stores single-precision numbers with four bytes, providing seven to eight digits of precision.

Repeatedly adding 0.1 eventually yields an error in the sixth digit.

```
100 FOR I=1 TO 20 STEP 0.1
110 PRINT I;
120 NEXT I        ' results in the following segment:
..... 7.6 7.7 7.79999 7.89999 7.99999 8.09999 8.2 8.3 8.4 ....
```

This happens because 0.1 cannot be represented exactly :

```
PRINT CDBL(0.1) ' yields 0.1000000014901161.
```

On general principle, when accumulating many numbers, do the arithmetic in double precision and convert the final result to single precision as required:

```
110 FOR I=1 TO 200 STEP 1  ' unit stepsize!
120 SUM#=SUM#+0.1D0
120 SUM#=SUM#+0.1D0
130 NEXT
140 PRINT SUM#       'GIVES 20.00000000000001
```

You should never compare real numbers for equality. Compare numbers within the precision possible on the computer, using the following technique:

```
100 TL=1E-7 ' seventh digit of precision
110 INPUT "ENTER X AND Y ";X,Y
```

```
120 IF ABS( (X - Y)/Y) <= TL PRINT "EQUAL"
                          ELSE PRINT "UNEQUAL"
```

If Y is equal to 0, modify the test by removing the division by Y in line 120. If X and Y are the result of other computer calculations, with only five significant digits, then TL = 1E – 5 is appropriate for the comparison.

Sometimes formulas from handbooks, textbooks, or articles are programmed directly without regard to the numerical difficulties that may be encountered. In general, whenever a formula subtracts two numbers, there is a loss of accuracy.

Consider the subtraction of nearly equal numbers. Suppose two single-precision numbers are equal in five places. The difference has only two significant figures. For example:

```
   1234.567
 - 1234.523
   .0440674     where 0674 = garbage digits
                        44 = two significant figures
```

Now consider the quadratic formula:

```
X = ( - B + SQR(B*B - 4*A*C))/(2*A)
```

The formula loses accuracy when 4*A*C is small compared with B*B. The resulting square root almost equals B, so that the difference in the numerator of the formula causes a loss of accuracy. To correct this, use the formula:

```
X = - 2*C/( B + SQR(B¢B - 4*A*C) )
```

A second way to lose accuracy is to add up a mixture of large and small numbers. If possible, sort the numbers in ascending order so that all the small numbers can be summed accurately before adding the remaining large numbers.

Multiplication and division do not produce serious arithmetic errors, except that the answers are truncated to seven or eight significant digits. Therefore, the following lines:

```
100 X = 1/11 : PRINT X,CDBL(X)
110 X = 11*X : PRINT X,CDBL(X)
```

produce

```
.0909091        .09090909361839295
1               1
```

One divided by 11 equals 0.0909090909090909. . . , an infinitely repeating decimal number. Its base 2 representation also repeats, so any attempt to store this number with a limited number of bytes will be inexact. Only numbers such as 0.5, 0.25, 0.375, 0.125, and 0.0625, which are all sums of negative powers of 2, can be represented exactly in a computer which does base 2 arithmetic. Therefore, the statement PRINT CDBL(0.0125) prints out 1.249999972060323D – 3.

Some formulas are sensitive to small changes in input values. For example, the equation of a line is Y=M*X+B, where M is the slope of the line, and B is the y-axis intercept of the line. Suppose the slope is very small, say 1E-6, and B is -1. The line crosses the x-axis at X= -B/M= 1,000,000. If B is changed to -1.001, a change of only 0.001, X becomes 1,001,000 (a change of 1000). The reason for the sensitivity is geometrically clear, but there are many other problems, such as curve-fitting, which are called ill-conditioned. The only way to cope with them in a program is to study the program outputs for extreme sensitivity to changes of the input values. To minimize the effects of single-precision arithmetic on such outputs, using double-precision arithmetic may help. In the above problem, if B was computed from other values, using a formula which included the subtraction of nearly equal numbers, the resulting X value would be very inaccurate.

In many statistical packages, the average (or mean) and standard deviation are computed after all the data has been input and converted to various sums, as follows:

```
90  DEFSNG A-Z                       'keep everything single precision
100 READ N                           'number of data points
110 S=0 : SS=0                       'zero these sums
120 FOR I=1 TO N
130 READ X                           'read in an input value
140 S=S+X                            'sum of the data points
150 SS=SS+X*X                        'sum of squares of data points
160 NEXT I
170 M=S/N                            'mean of the data points
180 SD=SQR((SS-S*S/N)/(N-1))         'standard deviation
190 PRINT "MEAN=" CDBL(M))           " STND DEV=" SD
200 DATA 3
210 DATA 6666123, 6666246, 6666369
220 END
```

The program prints out MEAN=6666246 STND DEV=0. The correct answers are MEAN =6666246 STND DEV =123. The arithmetic error occurs in line 180, where nearly equal quantities are subtracted, losing most of the seven significant figures. There are two solutions to this problem. You can convert all the variables to double precision or you can rewrite the program based on an alternative method of calculating mean and standard deviation:

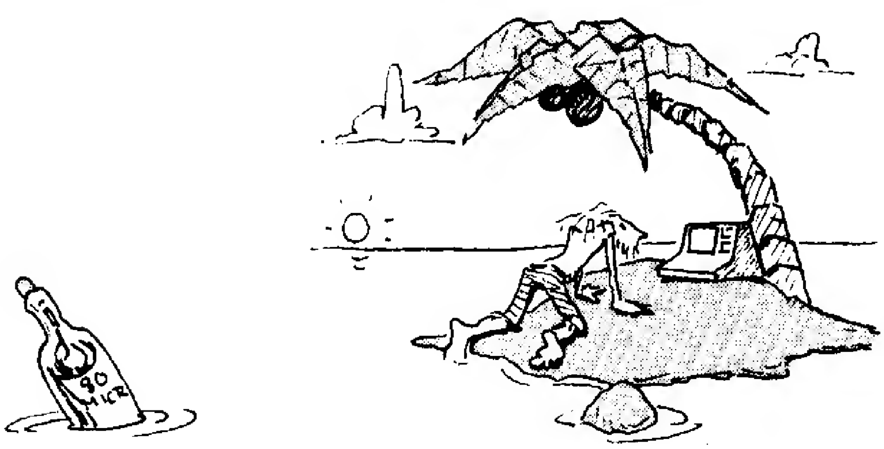
```
100 DEFSNG A-Z                       'all single precision
110 READ N                           'number of data points
120 S=0 : SS=0                       'zero the sums
130 FOR I=1 TO N                     'process n inputs
140 READ X                           'read in a data point
150 S=S+X                            'form only the sum of the points
160 NEXT I
170 M=S/N                            'mean of the points
180 RESTORE                          'reset the pointer to the data
190 READ N                           'input number of points
```

```
200 FOR I=1 TO N                 'process N inputs again
210 READ X                       'read A point
220 SS=SS+(X-M)*(X-M)            'sum of squared diff from mean
230 NEXT I
240 SD=SQR(SS/(N-1))
250 PRINT "MEAN = "M " STND DEV =" SD
260 DATA 3
270 DATA 6666123,6666246, 6666369
280 END
```

The following program calculates the best line through a set of N given points. It too suffers from arithmetic errors (in lines 200 and 210). The correct answers are M = 1 and B = –660,000. The program produces the values 1.52588E–5 and –10.1624:

```
100 DEFSNG A-Z                   'let all be single precision
110 READ N                       'N=number of point pairs
120 XY=0 : SX=0 : SY=0 : S2=0    'zero these sums
130 FOR I=1 TO N                 'process N points
140 READ X,Y                     'read a point pair
150 XY=XY+X*Y                    'sum of X*Y products
160 SX=SX+X                      'sum of the X values
170 SY=SY+Y                      'sum of the Y values
180 S2=S2+X*X                    'sum of X squared values
190 NEXT I
200 M=(XY-SX*SY/N)/(S2-SX*SX/N)
210 B=(SY-M*SX)/N
220 PRINT "THE BEST LINE THROUGH"N;
230 PRINT "DATA POINTS IS : Y=" M "*X+" B
240 STOP
250 DATA 3
260 DATA 665999,-1, 666000,0, 666001,1
```

If the DATA in line 260 were 999,–1, 1000,0, 1001,1, the program would correctly calculate M = 1 and B = –1000.



5

The Hidden Sort Routine

by Tom Mueller

System Requirements:
Model I, II, or III
Disk BASIC
16K RAM
One disk drive

You can sort numbers at incredible speeds using a machine-language routine already built into your TRS-80. All you have to do is fool the computer into thinking the numbers are line numbers in a program. It already has a BASIC sort function for line numbers, designed to allow the insertion of program lines. If you have a disk drive, you can easily adapt this ability to sorting whole numbers between 0 and 65,535. Duplicate numbers are lost, because BASIC does not allow a program to have identical line numbers.

Program Listing 1 generates 100 random numbers and saves them to disk in ASCII. It fools the computer into thinking that the random numbers in the SORT/DAT file are program line numbers. The computer then puts the line numbers into order.

The asterisk in line 100 of Program Listing 1 is required because the computer drops any line numbers not followed by a function, command, or character. Later, line 110 in Listing 2 removes the asterisk from the number and prints the number on the screen. Line 100 in Listing 1 also converts the random number into a non-numeric string. This lets you add one character before saving it to the disk file. Program Listing 3 lets you type in and sort your own numbers. After the prompt, type your numbers, pressing ENTER after each one. To stop, press ENTER without typing a number. The computer continues writing to the disk until the maximum number of entries is reached. If you enter a number less than 1 or greater than 65,535, the computer displays ERROR and asks you again to enter your number.

Program Listing 1

```
10 REM                  LISTING NUMBER 1
20 REM                  TOM MUELLER, PHOENIX, ARIZ.
30 REM
40 REM                  ME=MAX. NUMBER OF ENTRIES
50 ME=100
60 REM                  OPEN SEQUENTIAL FILE TO STORE NUMBERS IN

70 OPEN"O",1,"SORT/DAT"
80 REM                  GENERATE RANDOM NUMBERS
90 FOR I = 1 TO ME
100 A$=STR$(RND(9999))+"*"
110 PRINT LEFT$(A$,LEN(A$)-1)
120 REM                 WRITE RANDOM NUMBER ON DISK
130 PRINT #1, A$
140 NEXT I : CLOSE
150 REM                 DONE
160 PRINT"TYPE IN  LOAD ''SORT/DAT''  AND PRESS <ENTER>"
170 PRINT"THEN TYPE IN   SAVE ''SORT/DAT'',A  AND PRESS <ENTER>"

180 PRINT
190 PRINT"THE SORT IS DONE..."
200 PRINT"TO SEE THE NUMBERS,"
210 PRINT"TYPE IN THE SECOND PROGRAM (LISTING #2) AND"
220 PRINT"TYPE  RUN"
```

Program Listing 2

```
10 REM                  LISTING NUMBER 2
20 REM                  TOM MUELLER, PHOENIX, ARIZ.
30 REM
40 REM                  OPEN SEQUENTIAL FILE TO LOAD
50 REM                  SORTED NUMBERS BACK INTO COMPUTER.
60 OPEN"I",1,"SORT/DAT"
70 REM                  CHECK FOR END OF LIST
80 IF EOF(1) THEN CLOSE : END
90 INPUT #1, A$
100 REM                 DISPLAY NUMBER
110 PRINT LEFT$(A$,LEN(A$)-1)
120 GOTO 80
```

Program Listing 3

```
10 REM                  LISTING NUMBER 3
20 REM                  TOM MUELLER, PHOENIX, ARIZ.
30 REM
40 REM                  ME=MAX. NUMBER OF ENTRIES
50 ME=100
60 OPEN"O",1,"SORT/DAT"
70 REM                  ENTER NUMBERS HERE
80 FOR I = 1 TO ME
90 N$="" : INPUT "TYPE IN A NUMBER OR JUST PRESS <ENTER> TO QUIT
" ; N$
```

```
100 IF N$="" THEN 130
110 IF VAL(N$)<1 OR VAL(N$)>65535 THEN PRINT "ERROR" : GOTO 90
120 N$=N$+"*" : PRINT #1, N$ : NEXT I
130 CLOSE
140 PRINT"TYPE IN   LOAD''SORT/DAT''  AND PRESS <ENTER>"
150 PRINT"THEN TYPE IN  SAVE''SORT/DAT'',A   AND PRESS <ENTER>"
160 PRINT
170 PRINT"TO DISPLAY THE SORTED LIST, RUN THE PROGRAM SHOWN"
180 PRINT"IN LISTING NUMBER 2."
```

6

Testing Shell-Metzner Sort Routines

by T. W. Cleghorn

System Requirements
Model I or III
Level II BASIC
16K RAM

Recently I was looking for a good sorting algorithm to replace a binary search technique overloaded with increases in file size. I do not have a standard sort product for my TRS-80, so each application with data to sort must include its own sort routine. A diligent search of *80 Micro* revealed three programs that include Shell-Metzner sorts.

Doug Walker's "Beyond Shell Metzner," (*80 Microcomputing,* September 1980) provides an easy test data source, with its parameter driven, random string generator. Swapping pointers rather than swapping strings seems promising. Walker's program includes several other options: multiple field selection, ascending or descending sequences, and numeric or string data types. Stewart E. Fason's review of the B17 product (*80 Microcomputing,* March 1981) includes a driver test program with a variation on Shell-Metzner. Thomas C. Mehesan, Jr.'s "The Spare Time Generator" (May 1981) is also based on Shell-Metzner.

I defined and programmed a validation and timing experiment to prove and measure the three techniques. I report the results of my testing here. All times are in seconds, measured by the internal clock. I identify the three Shell-Metzner (S-M) algorithms by the author's name.

Binary vs. Fason

First to fall was the binary search algorithm. I used a production data file on disk as a data source and selected a varying number of data records from the file for several runs. I sorted the same set of records with each technique. It was no contest. The Fason S-M outperformed my bi-

nary technique by more than three to one at the 50-record level and reached eight to one at the 125 record mark.

Fason vs. Walker

I added the Fason algorithm to the Walker random string generation program. Fason won by a technical knock-out. I completed two runs with the same 50 records sorted by each algorithm. The sorting times, in seconds, are shown below.

Round	Fason	Walker	Ratio W/F
1	17	145	8.5/1
2	19	179	9.4/1

The Walker VARPTR swap routine hit an address greater than 32767 and died with a field overflow error. Since Walker was trailing by nine to one, I stopped the bout.

Mehesan vs. Fason

"The Spare Time Generator" by Mehesan includes a trim S-M algorithm in 15 lines of BASIC. I constructed another program combining Walker's data generator, the Mehesan algorithm and the Fason dreadnought and began a new set of time trials. Another clean sweep for Fason: after ten rounds the score was 1.36 seconds per record for Fason and 3.61 seconds per record for Mehesan (see Figure 1).

These statistics reveal a non-linear increase in sorting time per record as the number of records increase. I assumed this was due to the TRS-80 string packing algorithm. To test this theory I collected, combined and modified the various test programs used until now and developed the parameter-controlled sort test program SORT/TST (see the Program Listing).

		Fason		Mehesan	
Round	Records	Seconds	Seconds Per Rcd.	Seconds	Seconds Per Rcd.
1	10	2	0.2000	2	0.2000
2	25	6	0.2400	9	0.3600
3	50	14	0.2800	22	0.4400
4	75	27	0.3600	45	0.6000
5	100	52	0.5200	74	0.7400
6	100	54	0.5400	86	0.8600
7	125	71	0.5680	124	0.9920
8	150	110	0.7333	205	1.3667
9	200	351	1.7550	955	4.7750
10	500	1,129	2.2580	3,299	6.5980
Totals	1,335	1,816	1.3603	4,821	3.6112

Figure 1. *Fason vs. Mehesan*

				Seconds Per Record				
		Fason			Mehesan			
Run No.	Records	String	Floating Point	Integer	String	Floating Point	Integer
1	25	.32	.32	.32	.32	.32	.32
2	50	.34	.39	.40	.62	.50	.46
3	100	.51	.39	.40	1.08	.65	.57
4	150	.82	.4333	.4333	1.633	.6867	.6467
5	200	1.665	.46	.43	4.445	.75	.70
Ratio 5/1	8	5.2	1.43	1.34	13.89	2.34	2.18

Figure 2. *Data Type Analysis*

Statements		Function
10	70	Identification and prologue
80	210	Run parameters description
220		Run parameters—DATA statement
230	350	Interpret run parameters, establish the run environment
360	520	Generate the test data
530	540	Pass identification
550	610	Time and invoke Sort One
620	650	Reset the data array
660	720	Time and invoke Sort Two
730		Get parameter and test for another pass
740	750	End of job
760	810	Subroutine to verify sort results
820	850	Clock interface subroutine
860	870	Line print output
4000		Entry point to Sort One
5000		Entry point to Sort Two

Figure 3. *SORT/TST Structure*

Position	Form, Function and Use
1	A number that specifies the number of bytes to be reserved for strings, this number becomes the operand of a Clear
2	To specify Data Type, 0 = String, 1 = Numeric
3	0 = Integer, or 1 = Floating Point Numbers. Tested only if parameter 2 is a 1
4	1 = Print to Line Printer, 0 = Video Display only
5-N	This series defines the number of records per pass and the number of passes. The program terminates when a zero is read from this series.

Figure 4. *SORT/TST parameters*

SORT/TST

SORT/TST, a parameter driven program, facilitates the testing and measurement of two sorting algorithms. SORT/TST generates test data,

constructs data arrays, invokes and times two sorting algorithms, and reports the results to the video display and, optionally, to the line printer. The structure of SORT/TST is shown in Figure 3. Line 220 contains all the run parameters used by SORT/TST to perform a five-pass integer data test and write the results to the line printer. The run parameters are positional; they are read and interpreted based on the order in which they appear in the data statement. Their meanings are tabulated in Figure 4.

GOSUB statements at lines 570 and 680 invoke the two routines under test. Array T stores the data to be sorted, and integer variable N contains the number of records. The sort under test must be written as a closed routine that retains control until array T is sorted into ascending sequence and exits via a RETURN statement. A numeric array, B, is available for use by the sort under test. Other variables that may be tested but not changed are listed in Figure 5.

Floating Numbers

I defined SORT/TST run parameters to perform five passes, varying the number of records from 25 to 200 with each pass. I ran SORT/TST three times, setting the data type option to string, floating point numeric, and integer. The results of three runs of five passes each are shown in Figure 2. These measures support the theory that the string-packing routine accounts for the non-linear increases in sort time for string data.

With an eight-fold increase in records between runs one and five, the time per record for strings increased 5.2 times (Fason) and 13.89 times (Mehesan), while the integer time increased 1.43 times and 2.18 times, respectively.

Variable	Contents
A, AX, N	Number of records
D	Parm 1
KT!	Start Time in seconds
P2	Parm 2
P3	Parm 3
P4	Parm 4
PN	Current Pass Number
T1	Storage Array for Test Data

Figure 5. *Reserved variables*

Program Listing

```
10 ' PROGRAM "SORT/TST", TO COMPARE SORT TIME OF TWO
20 ' SORTING ALGORITHMS. THIS PARAMETER DRIVEN PROGRAM
```

Program continued

```
30 ' GENERATES THE TEST DATA, TIMES, CALLS, AND VERIFIES THE
40 ' RESULTS OF TWO SORTING ROUTINES AGAINST THE SAME DATA.
50 ' PARAMETERS ARE DEFINED BY THE FOLLOWING DATA STATEMENT
60 ' BY TWC COMPUTING,
70 ' HOUSTON, TEXAS
80 ' *********************************************************
90 ' THE PARAMETERS, VALUES, AND USE ARE AS FOLLOWS
100 ' D = NUMBER OF BYTES OF STRING DATA TO RESERVE
110 ' P2: Ø = GENERATE AND SORT CHARACTER STRINGS
120 '      1 = GENERATE AND SORT NUMERIC DATA
130 ' P3: (TESTED ONLY IF P2 = 1)
140 '      1 = SINGLE PRECISION FLOATING POINT NUMBERS
150 '      Ø = INTEGER NUMBERS
160 ' P4: 1 = PRINTED SORT STATISTICS ON LINE PRINTER
170 '      Ø = STATISTICS TO DISPLAY ONLY
180 ' A(1) THRU A(N)  = NUMBER OF RECORDS TO GENERATE AND
190 '    NUMBER OF PASSES, TERMINATED WHEN A(N) = Ø
200 ' *********************************************************
210 '    D,      P2,     P3,     P4,     A(1) THRU A(N)
220 DATA 1ØØØ, 1,      Ø,      1,     25,5Ø,1ØØ,15Ø,2ØØ,Ø
230 CLS: DEFINT A-S,U-Z
240 READ D
250 CLEAR D
260 READ D,P2,P3,P4,AX
270 ' GET HIGHEST REQUESTED RECORD COUNT FOR ARRAY SET
280 READ A: IF A > AX THEN AX = A
290 IF A > Ø THEN 28Ø
300 RESTORE: READ D,P2,P3,P4,A ' RESET PARMS
310 IF P4=1 THEN LPRINT"SORT TEST, PARMS =";D;P2;P3;P4;",";
320 IF P4=1 THEN IF P2=1 THEN LPRINT"NUMERIC DATA"; ELSE LPRINT"
STRING DATA"
330 IF P2 = 1 THEN 34Ø ELSE DEFSTR T: GOTO 36Ø
340 IF P3 = 1 THEN DEFSNG T ELSE DEFINT T
350 IF P4=1 THEN IF P3=1 THEN LPRINT", FLOATING POINT" ELSE LPRI
NT", INTEGER"
360 ' GENERATE RANDOM SORT RECORDS
370 ' *******************************************************
380 DIM T(AX), T1(AX), B(AX)
390 N=A: FOR I = 1 TO A
400   IF P2 = Ø THEN 43Ø ELSE T=RND(32767)
410   IF P3 = 1 THEN T = T * RND(1Ø)
420   GOTO 5ØØ
430 ' GENERATE CHARACTER STRINGS
440   T=""
450   B = RND(8)
460   FOR C = 1 TO B
470     T = T+CHR$(RND(26)+64)
480   NEXT C
490   T = T + " INPUT REC."+STR$(I)
500   T(I)=T
510   T1(I)=T
520 NEXT I
530 PN=PN+1: PRINT "*****  PASS  *****";PN;",";N;"RECORDS"
540 IF P4 = 1 THEN LPRINT:LPRINT "*****  PASS  *****";PN:LPRINT
550 GOSUB 82Ø: KT!=TX!  ' START TIME
560 ' ************** >>>>>  SORT NO. 1  <<<< ********************

570 GOSUB 4ØØØ '   <<<<<   PERFORM SORT NO. 1
580 GOSUB 82Ø: PRINT "SORT NO. 1 ELAPSED TIME = ";(TX!-KT!);"SEC
ONDS"
590 IF P4=1 THEN LPRINT"SORT NO. 1 ELAPSED TIME ="(TX!-KT!);"SEC
ONDS"
```

```
600 IF P4=1 THEN GOSUB 860
610 GOSUB 760
620 ' NOW TIME AND PERFORM SORT NO. 2
630 FOR I = 1 TO A       ' RESTORE T ARRAY
640   T(I) = T1(I)
650 NEXT I
660 GOSUB 820: KT!=TX! ' RECORD START TIME
670 ' ***************** >>>>  SORT NO. 2   <<<< ***************
680 GOSUB 5000  ' <<<<<   PERFORM SORT NO. 2
690 GOSUB 820  ' RECORD STOP TIME
700 PRINT "SORT NO. 2 ELAPSED TIME = ";(TX!-KT!);"SECONDS"
710 IF P4=1 THEN LPRINT"SORT NO. 2 ELAPSED TIME =";(TX!-KT!);"SE
CONDS": GOSUB 860
720 GOSUB760     ' TEST SORTED FILE
730 READ A: IF A < 1 THEN 740 ELSE 390
740 IF P4 = 1 THEN LPRINTCHR$(12);
750 END
760 ' TEST SORTED RESULTS
770 FOR I = 1 TO A-1
780   IF T(I) <= T(I+1) THEN 800
790   PRINT T(I);" > > > ";T(I+1)
800 NEXT I
810 RETURN
820 ' SUB-ROUTINE TO GET TIME IN SECONDS
830 X1$=RIGHT$(TIME$,8)          ' HH/MM/SS
840 TX!=(VAL(LEFT$(X1$,2)) * 3600) + (VAL(MID$(X1$,4,2)) * 60) +
 (VAL(RIGHT$(X1$,2)))
850 RETURN
860 LPRINT"SORTED";N;"RECORDS, AT";:LPRINTUSING"##.####";((TX!-K
T!)/N);:LPRINT" SECONDS PER RECORD"
870 RETURN
880 ' ************** END OF SORT/TST ***************
890 ' START SORT NO. 1 AT STATEMENT NO. 4000 AND SORT NO. 2 AT S
TATEMENT NO. 5000
4000 ' FROM "B17", STEWART E. FASON,
4010 ' 80/MICROCOMPUTING, MAR. '81
4020 L=1
4030 B(L) = N+1
4040 M=1
4050 J=B(L)
4060 I=M-1
4070 IF J-M < 3 THEN 4270
4080 M1= INT(RND(0)*(J-M))+M
4090 I = I + 1
4100 IF I = J THEN 4190
4110 IF T(I) <= T(M1) THEN 4090
4120 J = J - 1
4130 IF I = J THEN 4190
4140 IF T(J) >=T(M1) THEN 4120
4150 T = T(I)
4160 T(I) = T(J)
4170 T(J) = T
4180 GOTO 4090
4190 IF I >= M1 THEN I = I - 1
4200 IF J = M1 THEN 4250
4210 T = T(I)
4220 T(I) = T(M1)
4230 T(M1) = T
4240 L = L + 1
4250 B(L) = I
4260 GOTO 4050
4270 IF J-M < 2 THEN 4320
```

Program continued

```
4280 IF T(M) < T(M+1) THEN 4320
4290 T = T(M)
4300 T(M) = T(M+1)
4310 T(M+1) = T
4320 M = B(L) + 1
4330 L = L -1
4340 IF L > 0 THEN 4050
4350 RETURN
5000 ' "THE SPARE TIME GENERATOR", THOMAS C. MEHESEN, JR.
5010 ' 80/MICROCOMPUTING, MAY, 1981, PAGE 264
5020 M=N
5030 M = INT(M/2)
5040 IF M = 0 THEN RETURN
5050 L = 1: M1 = N - M
5060 I=L
5070 J = I + M
5080 IF T(I) <= T(J) THEN 5110
5090 T = T(I): T(I) = T(J): T(J) = T
5100 I = I - M: IF I < 1 THEN 5110 ELSE 5070
5110 L = L + 1: IF L>M1 THEN 5030 ELSE 5060
```

7

ASCII Converter

by David D. Busch

System Requirements:
Model I or III
Level II BASIC
16K RAM

What's ASCII, and why must it be converted? The answer lies in the different ways computers and humans process information.

People can handle mixtures of alpha and numeric characters, but computers recognize only binary numbers—ones and zeros. When string data is fed to a TRS-80, it must be converted to a series of numbers that the processor can handle. ASCII, or American Standard Code for Information Interchange, is one standard of communication that allows computers to exchange alphanumeric information in a form common to processors with differing operating systems and languages.

But, even if you have no modem, and aren't communicating with other computerists, it is often necessary to translate a string into the corresponding ASCII code, or vice versa. In some cases, when only a few characters need converting, a table of codes and their string values will do. Other times, longer messages need deciphering.

One good application for ASCII characters in programs is in game-writing. Writers of BASIC adventure programs may wish to hide messages from those casually listing the program. The CHR$(n) function can assign the desired string values to string variables called at appropriate points in the program. CHR$(n) returns a one-character string that corresponds to the ASCII code of n. For example, PRINT CHR$(65) produces an uppercase A on the screen.

A BASIC adventure might use a message such as: "Look in the hollow stump." This hint could be labeled H1$, and concatenated using CHR$(n), and the ASCII codes:

```
100 DATA 76,111,111,107,32,105,110,32,116,104,101,32,104,111,108,108,
     111,119,32,115,116,117,109,112,32
110 FOR N=1 TO 25:READ A
120 H1$=H1$+CHR$(A)
130 NEXT A
```

Use additional DATA lines and FOR-NEXT loops to put any number of messages into difficult-to-read-accidentally string variables. Of course, any knowledgeable programmer can pick the BASIC game apart, or enter PRINT H1$ from command mode once the program has been run past the initialization point. The object of this technique, however, is to protect the game player who innocently lists the program and wants to save the fun.

The same method can hide program credits within BASIC code. ASCII Converter (see Program Listing) accepts any keyboard input (in batches up to 255 characters each) and translates the alphanumerics into ASCII code, or converts an ASCII message back into the equivalent string. Those with Disk BASIC, Model III BASIC, or some other patch for the TRS-80 with LINEINPUT can best use this program. LINEINPUT allows you to feed any keyboard character, including commas and quotes, into the string to be translated into ASCII. If you have no LINEINPUT you may still be able to use this program; try changing the LINEINPUT in line 420 to a simple INPUT. Remember to use no string delimiters in your message.

ASCII Converter allows you to input a message of up to 100 lines, stored in a string array, MESS$(n), which is dimensioned in line 50. When you run the program, your instructions are displayed, and you choose video output only, or output to both the screen and a printer. (If printer output is desired, PFLAG is set to a value of 1 in line 250.)

The next menu displayed (lines 260–350) allows you to convert a string to ASCII code, or translate a series of ASCII numbers into the equivalent string. Your choice sets another flag, CH, to a value of either one or two in line 340. The ASCII or string message is input within a FOR-NEXT loop at lines 370–450. Be careful to enter the message correctly, with no typographical errors. The program does not differentiate between string and ASCII codes at this point; and, therefore, there is no check to see if ASCII numbers, if applicable, are valid (less than 255). It's possible to input nonsense. Because spaces (CHR$(32)) indicate the end of a group of ASCII numerals, a space is added to the end of input in line 440, if the user excludes it.

If the first three characters of the data input equal the string 999, signaling the end of message input, control exits from the loop at line 430 to the parsing subroutine at lines 470–680. Here, a FOR-NEXT loop is initiated at line 470 and performed as many times as the number of message lines that have been input, less one (FOR N1=1 to N−1). The final message line input will be 999, and should not be translated.

As each line of MESS$(n) is brought on line, a second loop, nested within the first, looks at each character and assigns its value temporarily to A$ (line 490). When the CH flag does not equal two, it indicates that the line is an ASCII series to be decoded, and control drops down to line 510, where the ASCII value of the character is returned. This number is listed to the screen, followed by three spaces, and, if PFLAG = 1, it is also sent to the printer. At this point, control branches to line 620, where N2 is incremented by one, signaling the examination of the next character in the string.

Should CH = 2, a different series of operations is performed on the character in A$. At line 520, the program looks to see if A$ is a space (CHR$(32)), in which case it knows that the parsed ASCII group is complete. Spaces are used to delimit the groups, because the ASCII code input may consist of one, two, or three numbers.

If A$ does not equal CHR$(32), then at line 550 it is concatenated onto the end of N3$. Working from left to right, the string representation of each of the numerals in a given code group is added to N3$ until it is complete. Then, the value of the string is assigned to the variable B (line 530), and CHR$(B) is listed to the screen, or printed. Then N3$ is nulled, and the next group of ASCII code is examined.

Program Listing

```
10 '    ************************************************
        *                                              *
        *              ASCII CONVERTER                 *
20 '    *                                              *
        *              DAVID D. BUSCH                  *
30 '    *              515 E. HIGHLAND AVE.            *
        *              RAVENNA, OHIO 44266             *
        *                                              *
        ************************************************

40 CLEAR 4000
50 DIM MESS$(100)

60 '****** INSTRUCTIONS ******

70 CLS
80 PRINT
90 PRINT
100 PRINT "     ###### ASCII CONVERTER ******"
110 PRINT
120 PRINT "THIS PROGRAM WILL CONVERT ANY CHARACTER OR "
130 PRINT "MESSAGE INPUT FROM THE KEYBOARD TO ITS ASCII"
140 PRINT "CODE.  IT WILL ALSO CONVERT ASCII CODE"
150 PRINT "BACK INTO A STRING.  ENTER SPACES BETWEEN"
160 PRINT "WORDS OR NUMBER PAIRS, AND ENTER '999'"
170 PRINT "WHEN FINISHED."
```

Program continued

```
180 PRINT
190 PRINT
200 PRINT "DO YOU WANT YOUR MESSAGE ALSO"
210 PRINT "DIRECTED TO LINE PRINTER?"
220 PRINT
230 PRINT " Y/N";
240 INPUT AN$
250 IF LEFT$(AN$,1)="Y" THEN PFLAG=1

260 CLS
270 PRINT
280 PRINT
290 PRINT "DO YOU WANT TO :"
300 PRINT "        1.) CONVERT STRING TO ASCII CODE"
310 PRINT "        2.) CONVERT ASCII CODE TO STRING EQUIVALENT"
320 PRINT
330 INPUT " ENTER CHOICE :";CH$
340 CH=VAL(CH$)
350 IF CH<1 OR CH>2 GOTO 330
360 '****** ENTER CHARACTERS OR MESSAGE ******

370 :  FOR N=1 TO 100
380 :    CLS
390 :    PRINT
400 :    PRINT
410 :    PRINT "ENTER LINE OF MESSAGE   (TYPE 999 WHEN FINISHED ) :"
420 :    LINEINPUT MESS$(N)
430 :    IF LEFT$(MESS$(N),3)="999" GOTO 470
440 :    IF RIGHT$(MESS$(N),1)<>CHR$(32) THEN
         MESS$(N)=MESS$(N)+CHR$(32)
450 :  NEXT N

460 '****** PARSE CHARACTER OR MESSAGE ******
'
470 :  FOR N1=1 TO N-1
480 :    FOR N2=1 TO LEN(MESS$(N1))
490 :      A$=MID$(MESS$(N1),N2,1)
500 :      IF CH=2 GOTO 520
510 :      A=ASC(A$):
           PRINT A;"    ";:
           IF PFLAG=1 THEN LPRINT A;"    ";:
           GOTO 620
520 :      IF A$<>CHR$(32) GOTO 550
530 :      B=VAL(N3$):
           PRINT CHR$(B);:
           IF PFLAG=1 THEN LPRINT CHR$(B);
540 :      GOTO 600
550 :      N3$=N3$+A$
560 :      NU=NU+1
570 :      IF NU=2 GOTO 620
580 :      IF A$=CHR$(32) GOTO 620
590 :      GOTO 620
600 :      NU=0
610 :      N3$=""
620 :    NEXT N2
630 :    PRINT
640 :    INPUT "HIT ENTER WHEN READY FOR NEXT LINE";A$
650 :    CLS
660 :    PRINT
670 :  NEXT N1
680 PRINT"END OF MESSAGE(S)" : END
```

8

Capture RST 10H: Customized BASIC Commands

by James Cargile

System Requirements:
Model I
Level II BASIC
Editor/assembler

The problem: you want a clear and easy-to-use link between a BASIC program and an assembly-language program that does not impair functioning of the BASIC interpreter or any of the ROM or Disk BASIC routines. One solution is to use RST 10H, otherwise known as the parser, to implement customized commands.

RST 10H is one of seven, 1-byte calls to the ROM. On execution of RST 10H, a return address is pushed into the stack, and the program counter is loaded with the address 0010H for execution. At 0010H in the ROM is a jump to user RAM address 4003H. At 4003H is a jump to the ROM routine at address 1D78H. The routine at 1D78H increments the HL register pair, loads the byte addressed by HL into the A register, and sets flags to indicate whether the byte contains a colon or null (indicating end of a BASIC text line), or a digit zero to nine, or other characters such as letters. The annotated code for the subroutine at 1D78H is shown in Figure 1. RST 10H is used frequently by other ROM routines because it is a 1-byte call and because it is useful in deciphering strings of text. Specifically, it is called by the keyboard driver, text editor, and BASIC interpreter portions of the ROM. Since RST 10H vectors to a user RAM address at 4003H it may be temporarily diverted to assembly-language routines by replacing the jump address to 1D78H with the address of any desired user routine. The only registers that must be controlled are the HL register pair, which usually points to the position in a BASIC text line, and the stack pointer, which contains a return to the routine calling RST 10H.

```
; **************  RST10  ********************
;
;
L1D78   INC     HL              ;INCREMENT READ POINTER
        LD      A,(HL)
        CP      3AH             ;IS CHARACTER A COLON?
        RET     NC              ;RETURN IF COLON OR
                                ;IF THIS IS A CHARACTER
        CP      20H             ;IS THIS A BLANK?
        JP      Z,L1D78H        ;IF SO, SKIP IT
        CP      0BH
        JR      NC,1D8BH        ;CANNOT BE A NULL
                                ;GO CHECK FOR DIGIT
        CP      09H
        JP      NC,1D78H        ;SKIP 09H AND 0AH
L1D8B   CP      30H             ;IF THIS A ZERO?
        CCF                     ;SET CARRY IF '0' TO '9'
                                ;RESET CARRY IF NULL
        INC     A               ;RESET Z FLAG IF '0'
        DEC     A               ;SET Z FLAG IF NULL
        RET
; ********** EXIT CONDITIONS ********************
;
; ** ZERO FLAG  *****  CARRY FLAG  ******  RESULT **
;     RESET       *      RESET       *   CHARACTER
;     SET         *      RESET       *   ':' OR NULL
;     RESET       *      SET         *   '0' TO '9'
; ****************************************************
```

Figure 1. *Annotated code for the subroutine at 1D78H*

Because of these features, RST 10H can easily intercept BASIC program execution, divert to a user subroutine, execute it, and return to the BASIC interpreter without the bother of DEFUSR and USR, error-trapping techniques, or use of BASIC tokens.

RST 10H *does* present three problems—all easily solved. Perhaps the most obvious problem is that you don't want to execute the assembly-language routine while entering or editing program text. The problem is solved by accepting only the calls to RST 10H from ROM address 1D5BH. The second problem may occur if your assembly-language routine uses RST 10H or calls a ROM routine which uses RST 10H. To prevent endless looping or stack overflow, give control of RST 10H back to the ROM before entering the user routine. After exiting the user routine, recapture RST 10H for further use. Finally, since you relinquish control of RST 10H upon entry to the user routine, any error in the user routine causes an exit to the BASIC interpreter, with no control over RST 10H. A simple error processor that recaptures RST 10H prior to processing the error eliminates this problem.

As an example of the potential uses of RST 10H, I have included portions of the code for a program MATRIX, which provides a set of matrix operations commands for use in BASIC programming. Each of the matrix operations subroutines is invoked by the command MAT and is fol-

lowed by various operations and functions. The command to multiply matrices B and C and place the result in matrix A is "MAT A = B*C. The technique of capturing RST 10H so that the customized command MAT can be identified is illustrated in the Program Listing.

The initialization portion of the code sets the top of memory and loads the address of the command processor (CMDPRO) into the RST 10H vector at 4004H. It also diverts the Disk BASIC error processor by placing the address of the error processor (ERRPRO) into the address 41A7H, replacing the usual vector to 57E6H. The command processor section saves the stack pointer and examines it to see if the call is from 1D5BH in the ROM and, if so, exits the user routine (via NOCMD1) without executing it, because the call is from text entry or the editor. The command processor then determines whether the MAT command is being scanned. If it is not, a continuation exit (via NOCMD) to 1D78H is used. If the MAT command is being read, the command processor relinquishes control of RST 10H and executes the user subroutine.

The user routine exits normally (via JPOUT) to the BASIC interpreter after reestablishing control of RST 10H. Abnormal exits due to errors are handled by the error processor which also recaptures RST 10H. The result is an effective method to call assembly-language routines from the direct mode or from a BASIC program. The customized commands are entered, edited, and executed in exactly the same manner as those provided by BASIC. Give it a try the next time you're combining assembly-language and BASIC programs.

Program Listing. *Example of code to use RST 10H for customizing BASIC commands*

```
                ;********** EXAMPLE OF CODE TO USE RST 10H **********
                ;********** IN IMPLEMENTING CUSTOMIZED      **********
                ;********** COMMANDS ON THE TRS-80 MOD i    **********
                ;
                ;
                ;********** INITIALIZATION **********
                ;
7000                        ORG     7000H
7000 211870     INIT        LD      HL,CMDPRO       ;ADDRESS OF COMMAND PROCESSOR
7003 220440                 LD      (4004H),HL      ;LOAD INTO RST 10H VECTOR
7006 21FF6F                 LD      HL,INIT-1
7009 22B140                 LD      (40B1H),HL      ;SET TOP OF MEM
700C 224940                 LD      (4049H),HL      ;DITTO
700F 217170                 LD      HL,ERRPRO       ;ADDRESS OF ERROR PROCESSOR
7012 22A741                 LD      (41A7H),HL      ;DIVERT DISK BASIC ERROR ROUTINE
7015 C3CC06                 JP      06CCH           ;EXIT TO BASIC AFTER INITIALIZATION
                ;
                ;********** COMMAND PROCESSOR **********
                ;
7018 ED737E70   CMDPRO      LD      (SPSAVE),SP     ;SAVE STACK POINTER
701C DDE1                   POP     IX              ;GET CONTENTS OF STACK
701E DD228070               LD      (RETURN),IX     ;SAVE IT
```

Program continued

```
7022 DDE5     00320          PUSH   IX            ;RESTORE CONTENTS OF STACK
7024 227C70   00330          LD     (BRDPTR),HL   ;SAVE BASIC INTERPRETER POINTER
7027 08       00340          EX     AF,AF'        ;SWAP REGISTER SETS
7028 D9       00350          EXX
7029 2A8070   00360          LD     HL,(RETURN)   ;EXAMINE CONTENTS OF STACK
702C 115B1D   00370          LD     DE,1D5BH      ;TO SEE IF CALL IS FROM INTERPRETER
702F DF       00380          RST    18H
7030 C25670   00390          JP     NZ,NOCMD1     ;IF TEXT ENTRY OR EDIT
7033 D9       00400          EXX                  ;SWAP BACK TO PRIMARY REGISTERS
7034 08       00410          EX     AF,AF'
7035 23       00420 SKPBLK   INC    HL            ;LOOK AT NEXT CHARACTER
7036 7E       00430          LD     A,(HL)        ;TO SEE IF IT IS A SPACE
7037 FE20     00440          CP     20H
7039 28FA     00450          JR     Z,SKPBLK      ;SKIP ALL SPACES
703B FE4D     00460          CP     'M'           ;IS THIS 1ST LETTER OF COMMAN?
703D C25870   00470          JP     NZ,NOCMD      ;IF NOT, RETURN TO INTERPRETER
7040 23       00480          INC    HL            ;GET NEXT CHARACTER
7041 7E       00490          LD     A,(HL)
7042 FE41     00500          CP     'A'           ;IS THIS 2D CHAR OF COMMAND?
7044 C25870   00510          JP     NZ,NOCMD      ;IF NOT RETURN TO INTERPRETER
7047 23       00520          INC    HL            ;GET NEXT CHARACTER
7048 7E       00530          LD     A,(HL)
7049 FE54     00540          CP     'T'           ;IS THIS THE LAST CHAR OF COMMAND?
704B C25870   00550          JP     NZ,NOCMD      ;IF NOT RETURN TO INTERPRETER
704E E5       00560          PUSH   HL            ;SAVE POINTER TO END OF VALID COMMAND
704F 21781D   00570          LD     HL,1D78H      ;ADDRESS OF RST 10H ROUTINE
7052 220440   00580          LD     (4004H),HL    ;RESTORE VECTOR TO RST 10H ROUTINE
7055 E1       00590          POP    HL            ;GET POINTER
              00600 ;
              00610 ;********** INSERT PROGRAM HERE.  MUST MAINTAIN CONTROL
              00620 ;********** OF THE POINTER SO THAT A CLEAN RETURN TO THE
              00630 ;********** BASIC INTERPRETER CAN BE ACCOMPLISHED AT THE
              00640 ;********** END OF THE USER ROUTINE.  EXIT TO JPOUT.
              00650 ;
              00660 ;********** EXIT HERE IF NO MATCH WITH COMMAND **********
              00670 ;
7056 08       00680 NOCMD1   EX     AF,AF'        ;SWAP BACK TO PRIMARY REGISTERS
7057 D9       00690          EXX
7058 2A7C70   00700 NOCMD    LD     HL,(BRDPTR)   ;GET INTERPRETER READ POINTER
705B ED7B7E70 00710          LD     SP,(SPSAVE)   ;GET STACK POINTER
705F C3781D   00720          JP     1D78H         ;GO PROCESS RST 10H
              00730 ;
              00740 ;********** EXIT HERE AT COMPLETION OF USER PGM *********
              00750 ;
7062 211870   00760 JPOUT    LD     HL,CMDPRO     ;ADDRESS OF COMMAND PROCESSOR
7065 220440   00770          LD     (4004H),HL    ;RECAPTURE RST 10H
7068 2A7C70   00780          LD     HL,(BRDPTR)   ;GET INTERPRETER READ POINTER
706B ED7B7E70 00790          LD     SP,(SPSAVE)   ;GET STACK POINTER
706F AF       00800          XOR    A             ;CLEAR CARRY AND ZERO 'A'
7070 C9       00810          RET                  ;TO BASIC INTERPRETER
              00820 ;
              00830 ;********** ERROR PROCESSOR **********
              00840 ;
7071 E5       00850 ERRPRO   PUSH   HL            ;SAVE READ POINTER
7072 211870   00860          LD     HL,CMDPRO     ;ADDRESS OF COMMAND PROCESSOR
7075 220440   00870          LD     (4004H),HL    ;RECAPTURE RST 10H
7078 E1       00880          POP    HL            ;GET READ POINTER
7079 C3E657   00890          JP     57E6H         ;GO PROCESS ERROR
              00900 ;
707C 0000     00910 BRDPTR   DEFW   0
707E 0000     00920 SPSAVE   DEFW   0
```

```
7080 0000       00930 RETURN  DEFW    0
                00940 ;
7000            00950         END     INIT            ;SET TRA ADDRESS TO INIT ROUTINE
00000 TOTAL ERRORS
```

9

Adding Commands to BASIC

by Alan R. Moyer

System Requirements:
Level II BASIC
16K RAM
Editor/assembler

Have you ever said to yourself, "I wish I had that command in my BASIC?" You *can* add your own commands.

BASIC is an interpretive language. It moves through your program listing, reading each command, deciding what it is to be done, and doing it, unless an error occurs (in which case it usually stops and tells you about it). Each BASIC command is stored in memory as a one-byte representation of the command. These representations are called tokens. When one is recognized, the interpreter looks it up in a table. The table tells where to go to execute the command. This process of interpreting your commands is what makes BASIC slow compared to machine-language programs, which are directly executed by the machine.

To get the BASIC interpreter to jump to a machine-language routine of your choice, put the new routine's address in the look-up table. When the appropriate command is encountered, BASIC will jump to the new routine.

BASIC keeps track of where it is in the program by reserving the Z80's HL register pair, so that it always points to the memory location of the character the interpreter is looking at. The A register contains the character at which the HL register pair is pointing. LD A,(HL) is a Z80 instruction BASIC uses to load the contents of the memory location pointed to by the HL register pair into the A register. Anytime the HL register pair is used in the execution of a BASIC command, its contents are saved and restored before returning to the BASIC interpreter. If the HL register pair is not restored, BASIC gets lost and the computer locks up.

When the interpreter recognizes a command and jumps to the appropriate routine, the HL register pair points to the next valid character after the command. You can pass information to a routine by placing the information after the BASIC command keywords.

Using NAME

For example, the NAME command is usually not used, but you can use it to pass two pieces of information to a machine-language program for processing. Put the address of the new routine into the look-up table, where the jump address for the NAME command is stored, with POKE 16783, X:POKE 16784, Y. Addresses 16783 and 16784 are the jump address for NAME. The command to be implemented is NAME A$,B$. This command exchanges the contents of A$ and B$ without using any temporary variables (for example, TEMP$ = A$:A$ = B$: B$ = TEMP$). The interpreter sees the NAME command and jumps to the proper address. The HL register pair then points to the next non-space character after NAME. In the example, HL points to the A in A$,B$.

Useful ROM Routines

Figure 1 contains addresses for useful ROM routines that can be used to get information about the arguments that are passed to the routine. To swap the two string variables in the new command, find the address value of each of the string variables (VARPTR), and switch the data for each string. (For a complete explanation of VARPTR and how the variables are stored in memory, see Radio Shack's *Level II BASIC Reference Manual*.) Once you know how to find the information for each variable, you can switch the string data and return to BASIC.

Three New Commands

The machine-language program in Program Listing 1 adds three new commands to BASIC.

NAME STR$ (SWAP) exchanges the contents of two specified string variables without using any string workspace.

NAME CVS (hexadecimal to decimal) converts any hexadecimal number in either a string literal or a string variable into its decimal equivalent in a specified integer variable.

NAME CVI (decimal to hexadecimal) converts any decimal number, either a numeric constant or integer numeric variable, into its hexadecimal equivalent in a specified string variable.

NAME STR$ (SWAP) Command

Program Listing 2 demonstrates the SWAP command. Three identical sets of string array variables are created, then swapped 100 times. Three different methods of swapping strings are timed for comparison.

Lines 10-190 initialize the string variables and ask which method of swapping is desired. String workspace cleanup, also known as garbage collection, is forced before each method. Method one uses a dummy variable to swap in line 390. This routine takes two minutes, 18 seconds. The major reason for this long time is garbage collection. By providing more initial string workspace (CLEAR 15000 bytes), garbage collection does not occur, and the swap time is only three seconds. That sounds impressive, but is unrealistic. If 15,000 bytes of string space is provided in a program, especially in a business program, most will be used and garbage collection will occur.

The method in lines 420-520 is faster and does essentially the same

BASIC's Accumulator

Useful for temporary storage of values during execution

	INT	SNG	DBL	STRING
411DH—			LSB	
411EH—			LSB	
411FH—			LSB	
4120H—			LSB	
4121H—	LSB	LSB	LSB	LSB=>$ DATA
4122H—	MSB	LSB	LSB	MSB=>$ DATA
4123H—		MSB	MSB	
4124H—		EXP	EXP	

40AFH—NTF (Number Type Flag) 2=INT, 3=STRING, 4=SNG, 8=DBL

0A7FH—Converts ACCUM to INT. Loads HL with ACCUM.

0E6CH—Converts ASCII string pointed to by HL to ACCUM and sets NTF accordingly. Zero is returned if the string is non-numeric.

0FBDH—Converts ACCUM to ASCII string for display. HL=string's address, DE=end of string plus one. ASCII string is terminated with a zero (null).

2337H—Evaluates the expression pointed to by HL. The ACCUM contains the result and NTF set accordingly. The expression is terminated with any valid delimiter. The terminator is pointed to by HL when finished. All error routines are contained in this subroutine (it flags type mismatch, for example).

2540H—Loads the ACCUM with specified variable's value whose ASCII representation is pointed to by HL. Sets NTF accordingly. ACCUM is zero if the variable is not found. HL points to the character after the ASCII of the variable.

25D9H—(RST 20H) Tests the NTF (at 40AFH). A register=NTF-3, Z set if NTF is a string, S set if INT, S reset and C set if SNG, S and C reset if DBL.

260DH—Gets the VARPTR of the specified variable. HL points to the ASCII representation of that variable (A$). If the variable does not exist in the variable table, it is created. DE points to the variable's address and NTF is set accordingly. HL points to the character following the ASCII representation of the variable.

2857H—Checks string workspace and reserves the number of bytes contained in the A register. The address of the work space is contained in 40D4H. Garbage collection takes place if necessary. An out-of-string error occurs if there's not enough room.

4467H—Outputs a message (DOS and Disk BASIC). HL points to the beginning of the ASCII message. Message is terminated with a zero (null).

Figure 1. *Important addresses and useful ROM routines*

thing as the NAME STR$ command. This method, however, swaps from BASIC, using the VARPTR statement to point to the string variable's data. This method takes 18 seconds, a definite improvement. The major advantage is that garbage collection never occurs, since all data manipulation is done with VARPTR pointers; no actual string operations are done.

The third method, in lines 530–580, uses the new NAME STR$ routine. All swaps are done as a single BASIC line (560) taking only two seconds. This improvement is especially noticed when doing a sort in BASIC.

NAME CVS and CVI

These are two common functions. Disk BASIC only partially addresses one, with its &H statement, which allows you to use hexadecimal constants instead of decimal. This Disk BASIC command only allows you to use hexadecimal literals, not string variables containing hexadecimal values. The NAME CVS command allows string variables with hexadecimal values to be used as hex constants. This machine-language routine is quite an advantage over a comparable BASIC routine. NAME CVI does conversions in the other direction, with the same advantages. Program Listings 3 and 4 are demonstration programs for NAME CVI and NAME CVS. For those without an editor/assembler, Program Listing 5 contains the NAME STR$/CVI/CVS routine as BASIC DATA statements. This program protects memory size automatically, then installs the new commands. Program Listings 6, 7 and 8 provide each of the commands in a single format. Each program protects memory size automatically and installs the appropriate command.

Don't be frightened by the length of the NAME STR$/CVI/CVS assembler listing. Much of it consists of comments explaining the concepts. The code only requires 290 bytes of memory.

Program Listing 1

```
00100 ;**********************************************************
00110 ;**     ** NAME STR$/CVI/CVS (SWAP/DECHEX/HEXDEC) **      **
00120 ;**                  By Alan R. Moyer                    **
00130 ;**                      07/10/81                        **
00140 ;**                    Version  1.0                      **
00150 ;**                                                      **
00160 ;** This supervisory routine checks the syntax of the    **
00170 ;** data following the BASIC NAME command word.          **
00180 ;** If the data is one of the tokens that represent      **
00190 ;** either STR$ (F4); indicating a SWAP command, or      **
00200 ;** CVI (E6); indicating a Dec to Hex conversion,        **
00210 ;** or CVS (E7); indicating a Hex to Dec conversion,     **
00220 ;** that command is then executed, otherwise a syntax    **
00230 ;** error is generated. See comments under the ind-      **
```

Program continued

```
                 ;** ividual commands for their explanations.            **
                 ;**   To initialize in BASIC;                           **
                 ;** POKE 16783,221: POKE 16784,254  (48K)              **
                 ;** POKE 16783,221: POKE 16784,190  (32K)              **
                 ;** POKE 16783,221: POKE 16784,126  (16K)              **
                 ;*********************************************************
                 ;
                 ;** Define labels
                 ;
260D             VARPTR  EQU     260DH    ;VARPTR subroutine ADDR
0AF4             CHKVAR  EQU     00AF4H   ;Check for $ VAR
7FFF             MEM16K  EQU     07FFFH   ;Top of 16K memory
BFFF             MEM32K  EQU     0BFFFH   ;Top of 32K memory
FFFF             MEM48K  EQU     0FFFFH   ;Top of 48K memory
4049             TOPMEM  EQU     4049H    ;Top of memory pointer
418F             NAME    EQU     418FH    ;NAME vector
402D             DOS     EQU     402DH    ;DOS reentry ADDR
0072             BASIC   EQU     0072H    ;BASIC reentry ADDR
2857             STRRM   EQU     2857H    ;String room check ADDR
2B02             EVALNO  EQU     2B02H    ;Evaluate the numeric exp.
2337             EVALST  EQU     2337H    ;Evaluate the string exp.
4121             ACCUM   EQU     4121H    ;ACCUM in BASIC
19A2             ERROR   EQU     19A2H    ;Error message routine ADDR
40AF             NTF     EQU     40AFH    ;NTF (Number Type Flag)
FFFF             MEMSIZ  EQU     MEM48K   ;Put your memory size here
                 ;
                 ;** Housekeeping
                 ;
FECE                     ORG     MEMSIZ-131H       ;
FECE 21DDFE      START   LD      HL,NAMCMD         ;HL=>New routine ADDR
FED1 228F41              LD      (NAME),HL         ;New ADDR (LII only)
FED4 21DCFE              LD      HL,NAMCMD-1       ;
FED7 224940              LD      (TOPMEM),HL       ;Set new memory size
FEDA C32D40              JP      DOS               ;Change to suit
                 ;
                 ;** Start of command decoder
                 ;
FEDD FEF4        NAMCMD  CP      0F4H              ;Is it STR$?
FEDF CA1DFF              JP      Z,SWAP            ;Yes, go process
FEE2 FEE6                CP      0E6H              ;Is it CVI?
FEE4 CAEFFE              JP      Z,DECHEX          ;Yes, go process
FEE7 FEE7                CP      0E7H              ;Is it CVS?
FEE9 CA58FF              JP      Z,HEXDEC          ;Yes, go process
FEEC C3A8FF              JP      SNERR             ;And print error
                 ;*********************************************************
                 ;**                   ** DECHEX **                      **
                 ;**                  By Alan R. Moyer                   **
                 ;**                     07/02/81                        **
                 ;**                    Version 2.1                      **
                 ;**                                                     **
                 ;** DECHEX is a machine language routine that will     **
                 ;** place a ASCII hex representation of an integer into**
                 ;** a specified string variable. It is executed as;     **
                 ;**                  NAME CVI A$,255                    **
                 ;**                       -or-                          **
                 ;**          NAME CVI A$(X),(A!+B#)*C%+2                **
                 ;**     (The CVI stands for ConVert from Integer)       **
                 ;** The string variable will be created if it does not **
                 ;** exist. This routine checks the string work space    **
                 ;** and will issue a 'garbage collection' if work       **
                 ;** space is insufficient. After that if there is       **
```

```
           ;** still not enough work space, an OUT OF STRING      **
           ;** SPACE error will occur. The numeric expression can **
           ;** can consist of variables and numeric values. This  **
           ;** expression will be evaluated and turned into an    **
           ;** integer value. This integer value will be in       **
           ;** standard RS BASIC integer convention, with values  **
           ;** over 32767 to be expressed as negative numbers.    **
           ;** Use the formula on page 8/6 of the Level II BASIC  **
           ;** Reference Manual (second edition) for number       **
           ;** conversions.                                       **
           ;*********************************************************
FEEF D7             DECHEX  RST     10H             ;Get next non blank char
FEF0 CD0D26                 CALL    VARPTR          ;Get VARPTR of VAR
FEF3 CDF40A                 CALL    CHKVAR          ;Make sure it's a $
FEF6 ED53F6FF               LD      (PTR1),DE       ;Save the VARPTR
FEFA E5                     PUSH    HL              ;Save the Char Pointer
FEFB 3E04                   LD      A,4             ;Need 4 chars work space
FEFD CD5728                 CALL    STRRM           ;Room? (40D4)=>work space
FF00 E1                     POP     HL              ;HL=>next char
FF01 23                     INC     HL              ;Jump over the delimiter
FF02 CD022B                 CALL    EVALNO  ;Eval the expr. DE=CINT(expr)
FF05 E5                     PUSH    HL              ;Save the char pointer
FF06 2AD440                 LD      HL,(40D4H)      ;HL=>$ work space
FF09 CDD2FF                 CALL    INTHEX          ;Convert DE to HEX$
FF0C 21D340                 LD      HL,40D3H        ;Get the $ data
FF0F ED5BF6FF               LD      DE,(PTR1)       ;Get the $ VARPTR
FF13 0603                   LD      B,3             ;Data counter
FF15 7E             AGAIN   LD      A,(HL)          ;A=HEX$ data
FF16 12                     LD      (DE),A          ;VARPTR=HEX$ data
FF17 23                     INC     HL              ;HL=>next HEX$ data
FF18 13                     INC     DE              ;DE>=next VARPTR address
FF19 10FA                   DJNZ    AGAIN           ;Do again if not done
FF1B E1                     POP     HL              ;Done, restore char pntr
FF1C C9                     RET                     ;And return to BASIC
           ;*********************************************************
           ;**                     ** SWAP **                      **
           ;**                  By Alan R. Moyer                   **
           ;**                      06/20/81                       **
           ;**                     Version 1.1                     **
           ;**                                                     **
           ;** SWAP is a machine language routine that will SWAP  **
           ;** the contents of two string variables as a direct   **
           ;** command from BASIC. It is executed as;             **
           ;**                  NAME STR$ A$,B$                    **
           ;**                        -or-                         **
           ;**            NAME STR$ A$(Z%),B$(B#,C!+2)             **
           ;** The string variables can be simple string var-     **
           ;** iables or array string variables. Any number of    **
           ;** array dimensions can be used. For array variables, **
           ;** the subscript descriptors can be numeric variables.**
           ;** This routine will swap the string variables WITH-  **
           ;** OUT USING ANY STRING WORKSPACE, WHICH MEANS THAT   **
           ;** GARGAGE COLLECTION WILL NEVER HAPPEN WHEN USING    **
           ;** THIS COMMAND! Both string variables will be        **
           ;** created if they do not exist, and their null       **
           ;** contents will be swapped.                          **
           ;*********************************************************
FF1D D7             SWAP    RST     10H             ;Get next non blank char
FF1E CD0D26                 CALL    VARPTR          ;Get VARPTR of 1st VAR
FF21 CDF40A                 CALL    CHKVAR          ;Make sure it's a $
FF24 ED53F6FF               LD      (PTR1),DE       ;Save the VARPTR
```

Program continued

```
FF28 DD21F8FF 01450          LD      IX,STRNG1       ;IX=> $ data buffer
FF2C CDBCFF   01460          CALL    STORE           ;Store the $ data
FF2F 23       01470          INC     HL              ;Jump over the delimiter
FF30 CD0D26   01480          CALL    VARPTR          ;Get VARPTR of 2nd VAR
FF33 CDF40A   01490          CALL    CHKVAR          ;Make sure it's a $
FF36 ED53FBFF 01500          LD      (PTR2),DE       ;Save the VARPTR
FF3A DD21FDFF 01510          LD      IX,STRNG2       ;IX=> $ data buffer
FF3E CDBCFF   01520          CALL    STORE           ;Store the $ data
FF41 DD2AF6FF 01530          LD      IX,(PTR1)       ;IX=> VARPTR of 1st VAR
FF45 FD21FDFF 01540          LD      IY,STRNG2       ;IY=> 2nd VAR data
FF49 CDBFFF   01550          CALL    SWITCH          ;Switch the $ data
FF4C DD2AFBFF 01560          LD      IX,(PTR2)       ;IX=> VARPTR of 2nd VAR
FF50 FD21F8FF 01570          LD      IY,STRNG1       ;IY=> 1st VAR data
FF54 CDBFFF   01580          CALL    SWITCH          ;Switch the $ data
FF57 C9       01590          RET                     ;And all done!
              01600 ;***********************************************************
              01610 ;**                      ** HEXDEC **                     **
              01630 ;**                        07/06/81                       **
              01640 ;**                      Version 1.0                      **
              01650 ;**                                                       **
              01660 ;** HEXDEC is a machine language routine that will       **
              01670 ;** convert hexadecimal numbers contained in string      **
              01680 ;** variables into their integer equivalents. The        **
              01690 ;** command is executed as such;                          **
              01700 ;**                  NAME CVS A%,A$                       **
              01710 ;**                        -or-                           **
              01720 ;**               NAME CVS A%,"FF"+A$                     **
              01730 ;**     (The CVS stands for ConVert from String.)         **
              01740 ;** The integer variable will be created if it does      **
              01750 ;** exist. The hexadecimal range is 0000 to FFFF.        **
              01760 ;** The integer variable will be created if it does      **
              01770 ;** not exist. The string characters can be up to four  **
              01780 ;** hexadecimal characters contained in either a         **
              01790 ;** string variable or string literal.                   **
              01800 ;** The integer equivalent will be expressed as stand-   **
              01810 ;** ard RS BASIC convention, with values over 32767 to   **
              01820 ;** be expressed as negative numbers.                     **
              01830 ;***********************************************************
FF58 D7       01840 HEXDEC   RST     10H             ;Get next non blank
FF59 CD0D26   01850          CALL    VARPTR          ;Get VARPTR of variable
FF5C ED53F6FF 01860          LD      (PTR1),DE       ;Save the VARPTR
FF60 3AAF40   01870          LD      A,(NTF)         ;Check the NTF
FF63 FE02     01880          CP      2               ;Was it an integer?
FF65 2046     01890          JR      NZ,TMERR        ;No, output an TM error
FF67 23       01900          INC     HL              ;Skip over the delimiter
FF68 CD3723   01910          CALL    EVALST          ;Evaluate the expression
FF6B CDF40A   01920          CALL    CHKVAR          ;Make sure it's a $
FF6E ED5B2141 01930          LD      DE,(ACCUM)      ;Get VARPTR data
FF72 E5       01940          PUSH    HL              ;Save char pointer
FF73 1A       01950          LD      A,(DE)          ;Get length of $
FF74 FE05     01960          CP      5               ;Is $ length < 5 chars?
FF76 303A     01970          JR      NC,OVERR        ;No, output an OV error
FF78 47       01980          LD      B,A             ;Put char count in A
FF79 13       01990          INC     DE              ;DE=>chars
FF7A EB       02000          EX      DE,HL           ;HL=>chars
FF7B 5E       02010          LD      E,(HL)          ;Put ADDR of chars
FF7C 23       02020          INC     HL
FF7D 56       02030          LD      D,(HL)          ;into DE
FF7E 210000   02040          LD      HL,00H          ;Zero the binary count
FF81 29       02050 HEXBIN   ADD     HL,HL           ;Bump the
FF82 29       02060          ADD     HL,HL           ;number left
```

```
FF83 29        02070         ADD    HL,HL          ;four
FF84 29        02080         ADD    HL,HL          ;places
FF85 1A        02090         LD     A,(DE)         ;A=char
FF86 FE3A      02100         CP     3AH            ;Higher than a "9"?
FF88 3808      02110         JR     C,NOATOF       ;No
FF8A FE41      02120         CP     41H            ;Lower than UC A?
FF8C 3829      02130         JR     C,FCERR        ;Yes
FF8E E6DF      02140         AND    0DFH           ;Adjust if LC
FF90 D607      02150         SUB    7              ;Adjust for A-F
FF92 D630      02160 NOATOF  SUB    30H            ;ASCII HEX to Binary
FF94 3821      02170         JR     C,FCERR        ;Error if < 0
FF96 FE10      02180         CP     10H            ;> 15?
FF98 301D      02190         JR     NC,FCERR       ;Yes
FF9A B5        02200         OR     L              ;Add with current #
FF9B 6F        02210         LD     L,A            ;Put total into L
FF9C 13        02220         INC    DE             ;DE=>Next char
FF9D 10E2      02230         DJNZ   HEXBIN         ;Do again if chars left
FF9F EB        02240         EX     DE,HL          ;DE=Integer value
FFA0 2AF6FF    02250         LD     HL,(PTR1)      ;HL=>VARPTR of Int VAR
FFA3 73        02260         LD     (HL),E         ;(HL)=LSB
FFA4 23        02270         INC    HL
FFA5 72        02280         LD     (HL),D         ;(HL)=MSB
FFA6 E1        02290         POP    HL             ;Restore char pointer
FFA7 C9        02300         RET                   ;And return
               02310 ;************************************************************
               02320 ;**                 NAME COMMAND SUBROUTINES              **
               02330 ;************************************************************
FFA8 1E02      02340 SNERR   LD     E,2            ;SN error code
FFAA C3A219    02350         JP     ERROR
FFAD 1E18      02360 TMERR   LD     E,24           ;TM error code
FFAF C3A219    02370         JP     ERROR
FFB2 1E0A      02380 OVERR   LD     E,10           ;OV error code
FFB4 C3A219    02390         JP     ERROR
FFB7 1E08      02400 FCERR   LD     E,8            ;FC error code
FFB9 C3A219    02410         JP     ERROR
               02420 ;
               02430 ;*** STORE and SWITCH subroutine
               02440 ;*** Stores data in a working buffer.
               02450 ;*** IY=>Source ADDR
               02460 ;*** IX=>Destination ADDR
               02470 ;*** A is destroyed
               02480 ;
FFBC D5        02490 STORE   PUSH   DE             ;Put the VARPTR into
FFBD FDE1      02500         POP    IY             ;the IY register
FFBF FD7E00    02510 SWITCH  LD     A,(IY+0)       ;A contains $ length
FFC2 DD7700    02520         LD     (IX+0),A       ;
FFC5 FD7E01    02530         LD     A,(IY+1)       ;A contains $ LSB
FFC8 DD7701    02540         LD     (IX+1),A       ;
FFCB FD7E02    02550         LD     A,(IY+2)       ;A contains $ MSB
FFCE DD7702    02560         LD     (IX+2),A       ;
FFD1 C9        02570         RET                   ;And return
               02580 ;*** INTEGER TO HEX$ UTILITY
               02590 ;*** DE contains integer value to be converted
               02600 ;*** HL=>buffer to contain the HEX$
               02610 ;*** A is destroyed
               02620 ;
FFD2 7A        02630 INTHEX  LD     A,D            ;A=MSB
FFD3 CDD7FF    02640         CALL   CONVRT         ;Convert it
FFD6 7B        02650         LD     A,E            ;A=LSB
FFD7 F5        02660 CONVRT  PUSH   AF             ;Save the digits
FFD8 CB3F      02670         SRL    A
```

Program continued

```
FFDA CB3F     02680          SRL     A
FFDC CB3F     02690          SRL     A
FFDE CB3F     02700          SRL     A
FFE0 CDEEFF   02710          CALL    CHEKIT      ;Convert to ASCII
FFE3 77       02720          LD      (HL),A      ;1st ASCII into buffer
FFE4 23       02730          INC     HL          ;Bump buffer pointer
FFE5 F1       02740          POP     AF          ;Get original digits
FFE6 E60F     02750          AND     0FH         ;Mask off high digits
FFE8 CDEEFF   02760          CALL    CHEKIT      ;Convert to ASCII
FFEB 77       02770          LD      (HL),A      ;2nd ASCII into buffer
FFEC 23       02780          INC     HL          ;Bump buffer pointer
FFED C9       02790          RET
FFEE C630     02800 CHEKIT   ADD     A,30H       ;Convert
FFF0 FE3A     02810          CP      03AH        ;0-9?
FFF2 F8       02820          RET     M           ;Yes, return it
FFF3 C607     02830          ADD     A,07H       ;Correct for A-F
FFF5 C9       02840          RET                 ;& return it
              02850 ;****************************************************************
              02860 ;**                        WORKSPACE                           **
              02870 ;****************************************************************
FFF6 0000     02880 PTR1     DEFW    0000H       ;General storage
0003          02890 STRNG1   DEFS    3           ;1st $ VARPTR storage
FFFB 0000     02900 PTR2     DEFW    0000H       ;2nd $ VARPTR data
0003          02910 STRNG2   DEFS    3           ;2nd $ VARPTR storage
              02920 ;
FECE          02930          END     START       ;Auto start
00000 TOTAL ERRORS
```

Program Listing 2

```
10 '** Demonstration program for the NAME STR$/CVI/CVS command
20 '** This routine demonstates the STR$ (SWAP) function
30 DEFINT D,X,Y
40 CLEAR 6500
50 POKE16783,225: POKE16784,254 '** Install new name vector
60 D=100
70 DIM A1$(D),A2$(D),A3$(D),B1$(D),B2$(D),B3$(D),C1$(D),C2$(D),C
3$(D)
80 CLS: PRINT"Initializing strings"
90 FOR X=0 TO D
100 A1$(X)=STRING$(RND(10),RND(25)+65): A2$(X)=A1$(X): A3$(X)=A1
$(X)
110 B1$(X)=STRING$(RND(10),RND(25)+65): B2$(X)=B1$(X): B3$(X)=B1
$(X)
120 C1$(X)=STRING$(RND(10),RND(25)+65): C2$(X)=C1$(X): C3$(X)=C1
$(X)
130 NEXT X
140 A1=0: A2=0: A3=0: B1=0: B2=0: B3=0: C1=0: C2=0: C3=0
150 CLS: PRINT"Which method ?? - 1, 2, OR 3"; X=0
160 A$=INKEY$: IF A$="1"ORA$="2"ORA$="3" THEN 200
170 X=X+1: IF X>4 THEN X=1
180 IF X=1 THEN PRINT@13,"  ";: PRINT@27,"3";: ELSE IF X=2 THEN
PRINT@18," ";: PRINT@13,"??";: ELSE IF X=3 THEN PRINT@21," ";: P
RINT@18,"1";: ELSE PRINT@27," ";: PRINT@21,"2";
190 FOR Y=0 TO 50: NEXT :GOTO 160
200 M=VAL(A$): CLS: PRINT@15,"EXCHANGE #";: PRINT@32,"FREE STRIN
G WORK SPACE";
210 GOSUB 590: PRINT@128,"Starting free string work space =";
```

```
220 PRINT @192,"Please wait...and wait... (garbage collection ta
king place)";: PRINT@162,FRE(X$);
230 PRINT@192,CHR$(30)
240 GOSUB 590
250 PRINT@256,"Press *ENTER* to start": X=0
260 A$=INKEY$: IF A$=CHR$(13) THEN 300
270 X=X+1: IF X>2 THEN X=1
280 IF X=1 THEN PRINT@262,"         ";: ELSE PRINT@262,"*ENTER*";
290 FOR Y=1 TO 50: NEXT: GOTO 260
300 PRINT@256,CHR$(30): ON M GOSUB 360,420,530
310 PRINT@704,"Press *ENTER* to continue";: X=0
320 A$=INKEY$: IF A$=CHR$(13) THEN PRINT@256,CHR$(31): GOTO 150
330 X=X+1: IF X>2 THEN X=1
340 IF X=1 THEN PRINT@710,"         ";: ELSE PRINT@710,"*ENTER*";
350 FOR Y=1 TO 50: NEXT: GOTO 320
360 PRINT@256,"Swapping variables using a dummy variable"
370 PRINT RIGHT$(TIME$,8)
380 FOR X=0 TO D : PRINT@84,X; :GOSUB 590
390 D$=A1$(X):A1$(X)=B1$(X):B1$(X)=C1$(X):C1$(X)=D$
400 NEXT X
410 PRINT@384,RIGHT$(TIME$,8): PRINT"Done!": RETURN
420 PRINT@256,"Swapping the strings using the VARPTR routine"
430 PRINT RIGHT$(TIME$,8)
440 FOR X=0 TO D : PRINT@84,X; :GOSUB 590
450 A1=PEEK(VARPTR(A2$(X))):A2=PEEK(VARPTR(A2$(X))+1):A3=PEEK(VA
RPTR(A2$(X))+2)
460 B1=PEEK(VARPTR(B2$(X))):B2=PEEK(VARPTR(B2$(X))+1):B3=PEEK(VA
RPTR(B2$(X))+2)
470 C1=PEEK(VARPTR(C2$(X))):C2=PEEK(VARPTR(C2$(X))+1):C3=PEEK(VA
RPTR(C2$(X))+2)
480 POKE(VARPTR(A2$(X))),B1:POKE(VARPTR(A2$(X))+1),B2:POKE(VARPT
R(A2$(X))+2),B3
490 POKE(VARPTR(B2$(X))),C1:POKE(VARPTR(B2$(X))+1),C2:POKE(VARPT
R(B2$(X))+2),C3
500 POKE(VARPTR(C2$(X))),A1:POKE(VARPTR(C2$(X))+1),A2:POKE(VARPT
R(C2$(X
510 NEXTX
520 PRINT@384,RIGHT$(TIME$,8): PRINT"Done!": RETURN
530 PRINT@256,"Swapping variables using the NAME command"
540 PRINTRIGHT$(TIME$,8)
550 FORX=0TOD:PRINT@84,X; :GOSUB 590
560 NAME STR$ A3$(X),B3$(X): NAME STR$ B3$(X),C3$(X)
570 NEXT X
580 PRINT@384,RIGHT$(TIME$,8):PRINT"Done!":RETURN
590 PRINT@100,(PEEK(&H40D6)+PEEK(&H40D7)*256)-(PEEK(&H40A0)+PEEK
(&H40A1)*256); :RETURN
```

Program Listing 3

```
10 '** Demonstration program for the NAME STR$/CVI/CVS command
20 '** This routine demonstrates the CVI (DECHEX) function
30 CLS: PRINT@192,"Initializing"
40 POKE 16783,221: POKE 16784,254 '** Install new name vector
50 DEF FN AD(A)=A+(A>32767)*65536 '** Convert to integer
60 DEFINT X,C,Y
70 DIM HX$(15)
80 DATA 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F
90 FOR X=0 TO 15: READ HX$(X): NEXT X
```

Program continued

```
1ØØ C=1ØØ
11Ø GOSUB 39Ø
12Ø CLS: GOSUB 44Ø: X=FRE(Z$)
13Ø PRINT@256,"Decimal to Hexadecimal conversion using BASIC"
14Ø PRINTRIGHT$(TIME$,8)
15Ø FOR X=1 TO C
16Ø D=PEEK(X)+PEEK(X+1)*256
17Ø BØ=INT(D/4Ø96)
18Ø B1=INT((D-BØ*4Ø96)/256)
19Ø B2=INT((D-((BØ*4Ø96)+(B1*256)))/16)
2ØØ B3=D-((BØ*4Ø96)+(B1*256)+(B2*16))
21Ø PRINT@78,HX$(BØ);HX$(B1);HX$(B2);HX$(B3);
22Ø PRINT@95,X;
23Ø NEXT X
24Ø PRINT@384,RIGHT$(TIME$,8)
25Ø PRINT"Done!"
26Ø PRINT: GOSUB 39Ø
27Ø CLS: GOSUB 44Ø: X=FRE(Z$)
28Ø PRINT@256,"Decimal to Hexadecimal conversion using NAME CVI"

29Ø PRINTRIGHT$(TIME$,8)
3ØØ FOR X=1 TO C
31Ø NAME CVI A$,FN AD(PEEK(X)+PEEK(X+1)*256)
32Ø PRINT@78,A$;
33Ø PRINT@95,X;
34Ø NEXT X
35Ø PRINT@384,RIGHT$(TIME$,8)
36Ø PRINT"Done!"
37Ø PRINT: GOSUB 39Ø
38Ø GOTO 12Ø
39Ø XØ=(PEEK(16416)+PEEK(16417)*256)-1536Ø: PRINT@XØ,"Press *ENT
ER* to continue";: X=Ø
4ØØ A$=INKEY$: IF A$=CHR$(13) THEN RETURN
41Ø X=X+1: IF X>2 THEN X=1
42Ø IF X=1 THEN A$="       ": ELSE A$="*ENTER*"
43Ø PRINT@XØ+6,A$;: FOR Y=1 TO 5Ø: NEXTY: GOTO 4ØØ
44Ø PRINT@1Ø,"HEX VALUE       STEP NUMBER";
45Ø RETURN
```

Program Listing 4

```
1Ø '** Demonstration program for the NAME STR$/CVI/CVS command
2Ø '** This routine demonstrates the CVS (HEXDEC) function
3Ø CLS: PRINT@192,"Initializing": CLEAR 5ØØ
4Ø POKE 16783,221: POKE 16784,254 '** Install new name vector
5Ø DEF FN AD(A)=A+(A>32767)*65536 '** Convert to integer
6Ø DEF FN HX(A$)=ASC(A$)+-48-7*(A$>"9")
7Ø DEFINT X,C,Y: DIM A$(1ØØ)
8Ø DIM HX$(15)
9Ø DATA Ø,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F
1ØØ FOR X=Ø TO 15: READ HX$(X): NEXT X
11Ø C=1ØØ
12Ø GOSUB 53Ø: X=FRE(Z$)
13Ø FOR X=1 TO C
14Ø D=PEEK(X)+PEEK(X+1)*256
15Ø BØ=INT(D/4Ø96)
16Ø B1=INT((D-BØ*4Ø96)/256)
17Ø B2=INT((D-((BØ*4Ø96)+(B1*256)))/16)
```

```
180 B3=D-((BØ*4Ø96)+(B1*256)+(B2*16))
19Ø A$(X)=HX$(BØ)+HX$(B1)+HX$(B2)+HX$(B3)
2ØØ PRINT@78,A$(X);
21Ø PRINT@95,X;
22Ø NEXT X
23Ø PRINT"Done!"
24Ø PRINT: GOSUB 48Ø
25Ø CLS: GOSUB 53Ø: X=FRE(A$)
26Ø PRINT@256,"Hexadecimal to Decimal conversion using BASIC"
27Ø PRINTRIGHT$(TIME$,8)
28Ø FOR X=1 TO C
29Ø N=Ø: FOR Y=1 TO LEN(A$(X)): N=N*16+FN HX(MID$(A$(X),Y,1)): N
EXT Y: N=FN AD(N)
3ØØ PRINT@78,N;
31Ø PRINT@95,X;
32Ø NEXT X
33Ø PRINT@384,RIGHT$(TIME$,8)
34Ø PRINT"Done!"
35Ø PRINT: GOSUB 48Ø
36Ø CLS: GOSUB 53Ø: X=FRE(A$)
37Ø PRINT@256,"Hexadecimal to Decimal conversion using NAME CVS"

38Ø PRINTRIGHT$(TIME$,8)
39Ø FOR X=1 TO C
4ØØ NAME CVS A$,A$(X)
41Ø PRINT@78,A$(X);
42Ø PRINT@95,X;
43Ø NEXT X
44Ø PRINT@384,RIGHT$(TIME$,8)
45Ø PRINT"Done!"
46Ø PRINT: GOSUB 48Ø
47Ø GOTO 25Ø
48Ø XØ=(PEEK(16416)+PEEK(16417)*256)-1536Ø: PRINT@XØ,"Press *ENT
ER* to continue";: X=Ø
49Ø A$=INKEY$: IF A$=CHR$(13) THEN RETURN
5ØØ X=X+1: IF X>2 THEN X=1
51Ø IF X=1 THEN A$="       ": ELSE A$="*ENTER*"
52Ø PRINT@XØ+6,A$;: FOR Y=1 TO 5Ø: NEXTY: GOTO 49Ø
53Ø PRINT@1Ø,"HEX VALUE        STEP NUMBER";
54Ø RETURN
```

Program Listing 5

```
5ØØØØ '** NAME STR$/CVI/CVS (SWAP/DECHEX/HEXDEC) command using B
ASIC's NAME command
5ØØ1Ø M=65244 'for 48K, 4886Ø For 32K, 32476 for 16K
5ØØ2Ø X2=INT(M/256): X1=M-X2*256: POKE 16561,X1: POKE 16562,X2:
CLEAR 5Ø 'This sets memory size from within BASIC
5ØØ3Ø SA=-291 'for 48K, -16675 for 32K, 32477 for 16K
5ØØ4Ø FOR X= SA TO SA+29Ø: READY
5ØØ5Ø IF Y=888 THEN Y=254 'for 48K, 19Ø for 32K, 126 for 16K
5ØØ6Ø IF Y=999 THEN Y=255 'for 48K, 191 for 32K, 127 for 16K
5ØØ7Ø POKE X,Y: NEXT X
5ØØ8Ø POKE 16783,221: POKE 16784,254 'for 48K, 19Ø for 32K, 126
for 16K ** Install new NAME vector
5ØØ9Ø DATA 254,244,2Ø2,29,999,254,23Ø,2Ø2,239,888,254,231,2Ø2,88
,999
5Ø1ØØ DATA 195,168,999,215,2Ø5,13,38,2Ø5,244,1Ø,237,83,246,999,2
29
```

Program continued

```
50110 DATA 62,4,205,87,40,225,35,205,2,43,229,42,212,64,205
50120 DATA 210,999,33,211,64,237,91,246,999,6,3,126,18,35,19
50130 DATA 16,250,225,201,215,205,13,38,205,244,10,237,83,246,99
9
50140 DATA 221,33,248,999,205,188,999,35,205,13,38,205,244,10,23
7
50150 DATA 83,251,999,221,33,253,999,205,188,999,221,42,246,999,
253
50160 DATA 33,253,999,205,191,999,221,42,251,999,253,33,248,999,
205
50170 DATA 191,999,201,215,205,13,38,237,83,246,999,58,175,64,25
4
50180 DATA 2,32,70,35,205,55,35,205,244,10,237,91,33,65,229
50190 DATA 26,254,5,48,58,71,19,235,94,35,86,33,0,0,41
50200 DATA 41,41,41,26,254,58,56,8,254,65,56,41,230,223,214
50210 DATA 7,214,48,56,33,254,16,48,29,181,111,19,16,226,235
50220 DATA 42,246,999,115,35,114,225,201,30,2,195,162,25,30,24
50230 DATA 195,162,25,30,10,195,162,25,30,8,195,162,25,213,253
50240 DATA 225,253,126,0,221,119,0,253,126,1,221,119,1,253,126
50250 DATA 2,221,119,2,201,122,205,215,999,123,245,203,63,203,63

50260 DATA 203,63,203,63,205,238,999,119,35,241,230,15,205,238,9
99
50270 DATA 119,35,201,198,48,254,58,248,198,7,201,0,0,254,58
50280 DATA 248,0,0,201,28,108
```

Program Listing 6

```
50000 '** NAME CVS (HEXDEC) command using BASIC's NAME command
50010 M=65429 'for 48K, 49045 for 32K, 32661 for 16K
50020 X2=INT(M/256): X1=M-X2*256 :POKE 16561,X1: POKE 16562,X2:
CLEAR 50 'This sets memory size automatically from within BASIC
50030 SA=-106 'for 48K, -16490 for 32K, 32662 for 16K
50040 FOR X= SA TO SA+105: READY
50050 IF Y=999 THEN Y=255 'for 48K, 191 for 32K, 127 for 16K
50060 POKE X,Y: NEXT X
50070 POKE 16783,150: POKE 16784,255 'for 48K, 191 for 32K, 127
for 16K ** Install new NAME vector
50080 DATA 254,231,32,80,215,205,13,38,237,83,254,999,58,175,64
50090 DATA 254,2,32,70,35,205,55,35,205,244,10,237,91,33,65
50100 DATA 229,26,254,5,48,58,71,19,235,94,35,86,33,0,0
50110 DATA 41,41,41,41,26,254,58,56,8,254,65,56,41,230,223
50120 DATA 214,7,214,48,56,33,254,16,48,29,181,111,19,16,226
50130 DATA 235,42,254,999,115,35,114,225,201,30,2,195,162,25,30
50140 DATA 24,195,162,25,30,10,195,162,25,30,8,195,162,25,0
50150 DATA 0
```

Program Listing 7

```
50000 '** NAME CVI (DECHEX) command using BASIC's NAME command
50010 M=65442 'for 48K, 49058 for 32K, 32674 for 16K
50020 X2=INT(M/256): X1=M-X2*256: POKE 16561,X1: POKE 16562,X2:
CLEAR 50 'This sets memory size automatically from within BASIC
50030 SA=-93 'for 48K, -16477 for 32K, 32675 for 16K
50040 FOR X= SA TO SA+92: READY
```

```
50050 IF Y=999 THEN Y=255 'for 48K, 191 for 32K, 127 for 16K
50060 POKE X,Y: NEXT X
50070 POKE 16783,163: POKE 16784,255 'for 48K, 191 for 32K, 127
for 16K ** Install new NAME vector
50080 DATA 254,230,40,5,30,2,195,162,25,215,205,13,38,205,244
50090 DATA 10,237,83,254,999,229,62,4,205,87,40,225,35,205,2
50100 DATA 43,229,42,212,64,205,218,999,33,211;64,237,91,254,999

50110 DATA 6,3,126,18,35,19,16,250,225,201,122,205,223,255,123
50120 DATA 245,203,63,203,63,203,63,203,63,205,246,999,119,35,24
1
50130 DATA 230,15,205,246,999,119,35,201,198,48,254,58,248,198,7

50140 DATA 201,0,0
```

Program Listing 8

```
50000 '** NAME STR$ (SWAP) command using BASIC's NAME command
50010 M=65435 'for 48K, 49051 for 32K, 32667 for 16K
50020 X2=INT(M/256): X1=M-X2*256: POKE 16561,X1: POKE 16562,X2:
CLEAR 50 'This sets memory size automatically from within BASIC
50030 SA=-100 'for 48K, -16484 for 32K, 32668 for 16K
50040 FOR X=SA TO SA+99: READY
50050 IF Y=999 THEN Y=255 'for 48K, 191 for 32K, 127 for 16K
50060 POKE X,Y: NEXT X
50070 POKE 16783,156: POKE 16784,255 'for 48K, 191 for 32K, 127
for 16K ** Install new NAME vector
50080 DATA 254,244,40,5,30,2,195,162,25,215,205,13,38,205,244
50090 DATA 10,237,83,246,999,221,33,248,999,205,224,999,35,205,1
3
50100 DATA 38,205,244,10,237,83,251,999,221,33,253,999,205,224,9
99
50110 DATA 221,42,246,999,253,33,253,999,205,227,999,221,42,251,
999
50120 DATA 253,33,248,999,205,227,999,201,213,253,225,253,126,0,
221
50130 DATA 119,0,253,126,1,221,119,1,253,126,2,221,119,2,201
50140 DATA 191,104,0,0,0,0,0,0,0,0
```

10

Programming in Radio Shack's Tiny Pascal

by John Blommers

System Requirements:
Model I
Level II BASIC
16K RAM

Tiny Pascal can give you programs which execute quickly, up to ten times faster than interpreted BASIC programs. Despite the limited integer and integer array data types, Tiny Pascal provides all of the structured statements of standard Pascal. With a little ingenuity, you can write many useful programs. Each program in this chapter contains comment lines and is accompanied by an explanation in the text.

Celsius to Fahrenheit Conversion

The integer arithmetic limitation requires that the formula $F = C*9/5 + 32$ be rewritten as $F = (C*18+5)/10+32$. The 1.8 has been translated to 18/10, and adding 5 inside the parentheses before dividing by 10 results in rounding instead of truncation. This procedure gives the most accurate integer answer possible.

```
(* CELSIUS TO FAHRENHEIT CONVERSION *)
(* THIS PROGRAM IS WRITTEN IN RADIO SHACK'S TINY PASCAL.  SINCE ONLY
INTEGERS ARE SUPPORTED, MULTIPLICATION BY 1.8 IS DONE BY MULTIPLYING BY
18, ADDING 5 FOR ROUNDING, AND DIVIDING BY 10. *)
CONST LOW   = 0 ;         (* FIRST TEMPERATURE TO CONVERT *)
      HIGH  = 41 ;        (* LAST  TEMPERATURE TO CONVERT *)
      F32   = 32 ;
      ROUND = 5  ;        (* ROUNDING CONSTANT *)
VAR DEGREE, FLAG : INTEGER ;    (* GLOBAL VARIABLES *)
BEGIN                           (* OF MAIN PROGRAM *)
 WRITE(13) ; WRITE('CENTIGRADE TO FAHRENHEIT CONVERSION',13,13);
 WRITE('---------',13);
   FOR DEGREE := LOW TO HIGH DO
      BEGIN
```

```
        WRITE(DEGREE#,'C    ',((DEGREE*18+ROUND) DIV 10)+F32#,'F    ');
        IF DEGREE THEN WRITE(13)   (* CRLF IF DEGREE IS ODD *)
      END;
 WRITE('---------',13);
 WRITE(13,'*** PROGRAM STOP ***',13,13);
END.       (* OF CELSIUS TO FAHRENHEIT PROGRAM *)
```

Equation Solving Program

This program finds all the integer solutions to the equation 6*X+4*Y − 14*Z = 10 for values of X, Y, and Z from 0 to 100. The procedure is very elementary; it does an exhaustive search of all possible combinations of X, Y, and Z. The program uses INKEY to sense if the S key has been pressed during execution and stops if it has. Pressing the BREAK key twice is an alternative.

```
(* THIS PROGRAM PRINTS ALL 1454 OR SO OF THE SOLUTIONS TO THE FORMULA
6X+4Y-14Z=10. *)
VAR X,Y,Z : INTEGER ;
BEGIN
   WRITE(13,13,'SOLUTIONS (X,Y,Z) TO 6X+4Y-14Z=10',13,13) ;
   FOR X := 0 TO 100 DO         (* 3 EXHAUSTIVE LOOPS *)
   FOR Y := 0 TO 100 DO
   FOR Z := 0 TO 100 DO
      BEGIN    (* STRIKE THE 'S' KEY TO HALT THE PROGRAM *)
      IF INKEY = 'S' THEN BEGIN X:=100;Y:=100;Z:=100 END ;
      IF (6*X + 4*Y - 14*Z = 10) THEN
           WRITE('(',X#,'  ',Y#,'  ',Z#,')')
      END ;
   WRITE(13,13,13,13)   (* SEND A FEW LINE FEEDS *)
END.     (* OF EQUATION SOLVER PROG *)
```

Square and Cube Roots

This program lets you calculate square and cube roots for integers less than or equal to 32767. It does so by guessing initially and halving the error of its guess (by taking the middle between a low and a high limit) until the uncertainty is not greater than the constant tolerance.

```
(* SQUARE AND CUBE ROOT PROGRAM *)
(* PUT GLOBAL VARIABLES ETC UP HERE *)
VAR NUMBER : INTEGER ;
FUNC SQUAREROOT(NUMBER,POWER) ; (* POWER=1 NO ROOT, 2=SQUARE ROOT,
                                                     3=CUBE ROOT
 CONST TOLERANCE=1 ;
 VAR UPPER,LOWER,MIDDLE,PRODUCT : INTEGER ;
 BEGIN
   LOWER :=1 ; CASE POWER OF 1: UPPER:=1 ; (* FIX LOWER, UPPER LIMITS *)
                             2: IF NUMBER)182 THEN UPPER:=182
                                              ELSE UPPER:=NUMBER;
                             3: IF NUMBER)032 THEN UPPER:=032
                                              ELSE UPPER:=NUMBER
             END (* OF CASE *) ;
   WHILE (UPPER-LOWER) ) TOLERANCE DO (* ITERATE WHILE UNCERTAINTY *)
      BEGIN                          (* EXCEEDS TOLERANCE *)
         MIDDLE := (UPPER+LOWER) DIV 2 ;
         CASE POWER OF 1: PRODUCT := MIDDLE ;          (* NO ROOT *)
```

Program continued

```
                          2: PRODUCT := MIDDLE*MIDDLE ;    (* SQUARE ROOT *)
                          3: PRODUCT := MIDDLE*MIDDLE*MIDDLE (*CUBE ROOT *)
         END (* OF CASE *) ;
         IF PRODUCT (= NUMBER THEN LOWER := MIDDLE (* RECALCULATE THE *)
                                   ELSE UPPER := MIDDLE ; (* NEW *)
      END ;                                            (* BOUNDARIES *)
   SQUAREROOT := (UPPER+LOWER) DIV 2 (* CALCULATE FINAL ANSWER *)
END (* OF SQUAREROOT *) ;

BEGIN (* OF MAIN PROGRAM *)
 WRITE('ENTER A NUMBER ') ; READ(NUMBER#) ;
 WRITE('THREE ROOTS ARE ',SQUAREROOT(NUMBER,1)#,'    ',
                          SQUAREROOT(NUMBER,2)#,'    ',
                          SQUAREROOT(NUMBER,3)#,13)
END.   (* OF ROOT PROGRAM *)
```

Another Square Root Program

This program demonstrates a unique approach to determining square roots. It counts the number of binary digits in the number and shifts half of them to the right as a first estimate of the square root. Three Newton iterations are done to produce a second estimate. This estimate is in error by, at most, plus or minus one, due to the round-off errors in the integer arithmetic. The program checks the second estimate, along with values of one greater and one less than the estimate. The one with the least error is returned as the square root of the argument passed. The following example calculates the square root of Y = 20:

20 is binary 10100 and has 5 binary digits
first estimate is 10 binary = 2
second estimate (after 3 Newtons) is 4
4 − 1 = 3 error = 20 − 9 = 11
4 = 4 error = 20 − 16 = 4 (best of the three)
4 + 1 = 5 error = 20 − 25 = −5
final answer = 4

```
VAR Z,I : INTEGER ;   (* SQUARE ROOT PROGRAM *)
FUNC SQRT(Y);
VAR X,E1,E2,E3,I,YY  : INTEGER ;
BEGIN
 IF Y ( 0 THEN Y := 0 ; (* TRAP NEGATIVE ARGUMENTS *)
   CASE Y OF
 0,1 : SQRT := Y          (* TRIVIAL CASES *)
   ELSE  BEGIN
   I := 1 ;  YY := Y  ;
   WHILE YY ) 0 DO BEGIN      (* COUNT # BINARY DIGITS IN ARGUMENT *)
                     I := I+1 ;
                     YY := YY SHR 1
                   END ;
   X := Y SHR ( I SHR 1 ) ;     (* FIRST ESTIMATE OF ROOT *)
   FOR I := 1 TO 3 DO X := Y DIV (X+X) + X SHR 1 ; (* 3 NEWTONS *)
   E1 := ABS(Y-SQR(X-1)) ; (* THREE ERRORS CALCULATED *)
   E2 := ABS(Y-SQR(X   )) ;
   E3 := ABS(Y-SQR(X+1)) ;
   SQRT := X ;
   IF E1 ( E2 THEN SQRT := X-1 ; (* RETURN SQRT WITH LEAST ERROR *)
   IF E3 ( E2 THEN SQRT := X+1
         END (* ELSE *)
   END (* CASE *)
END; (* OF SQRT *)
```

```
BEGIN           (* MAIN USER PROGRAM BEGINS HERE *)
    FOR I := 0 TO 127 DO BEGIN  (* PLOT THE SQRT FUNCTION *)
              PLOT(I,47-4*SQRT(I),1)
                    END ;
   Z := 1 ;
   WHILE Z > -1 DO BEGIN        (* LET USER TYPE IN VALUES TO TEST *)
                  WRITE('ENTER Z ') ;
                  READ(Z#) ;
                  WRITE('SQRT(',Z#,')= ',SQRT(Z)#,13,13) ;
                END
END. (* OF SQUARE ROOT PROGRAM *)
```

Random Number Generator with Plotting

This program uses a function that generates a pseudo-random number, RND. The function depends on the overflow of integer multiplication. Note that when the result of such a multiplication is negative, the sign bit must be cleared with the MOD function. The number is not made positive with the ABS function. Run the program with a few different seeds to see just how pseudo-random the sequence is.

```
(* RANDOM NUMBER GENERATION FOR TINY PASCAL
   REF: PASCAL, BY DAVID L. HEISERMAN P 148, TAB BOOK 1205 *)
VAR I,RLOW,RHIGH,NUM,N : INTEGER;
FUNC RND(RLOW,RHIGH); (* RETURNS RANDOM # BETWEEN RLOW & RHIGH *)
   VAR M,P:INTEGER;    (* LOCAL VARIABLES *)
   BEGIN
   REPEAT
      M:=N*3125;        (* 3125 IS THE MULTIPLIER *)
      IF M<0 THEN M:=(M AND 32767)  (* MASK SIGN BIT IF REQUIRED *)
      N:=M ; P:=M;      (* N IS EXTERNAL TO THE RND FUNCTION *)
      P:= P MOD RHIGH
   UNTIL (P)=RLOW) AND (P<= RHIGH);  (* QUIT IF P IS IN RANGE *)
   RND:=P                       (* ASSIGN RND A VALUE AND RETURN *)
   END; (* OF RND *)

BEGIN                           (* MAIN PROGRAM EXERCISES RND *)
   WRITE('ENTER THE NONZERO RANDOM NUMBER SEED ');
   READ(N#);
   WRITE('HOW MANY RANDOM NUMBERS DO YOU WANT ');
   READ (NUM#);
   WRITE('STATE THE RANGE OF THESE POSITIVE NUMBERS ');
   READ(RLOW#,RHIGH#);
   FOR I:=1 TO NUM DO WRITE(RND(RLOW,RHIGH)#,'    ');
   WRITE(13,'HIT A KEY TO BEGIN PLOTTING 10000 RANDOM NUMBERS');
   READ(I);
   WRITE(28,31); (* CLEAR SCREEN *)
   FOR I:=1 TO 10000 DO PLOT( RND(0,127), RND(0,47) ,1)
END.                            (* OF RANDOM NUMBER PROGRAM *)
```

Another Random Number Generator

This program uses a different multiplier, MULT, and introduces an increment, INCR. The MOD function keeps the number in range, and the AND function keeps the numbers positive. The main program produces a histogram plot of the random numbers as they are generated.

```
VAR I,J,K,SEED : INTEGER ;   (* ANOTHER RANDOM # GENNER/PLOTTER *)
        XARRAY : ARRAY(127) OF INTEGER ;
FUNC RAND ;
CONST           (* DEFINE THE MULTIPLIER, INCREMENT AND MODULUS *)
   MULT = 25173 ;
   INCR = 13849 ;
   MODU = 16384 ;
BEGIN
   RAND := SEED ;    (* APPLY THE EXTERNAL SEED *)
   SEED := (MULT*SEED+INCR) MOD MODU ; (* CONTROL MAGNITUDE *)
   SEED := SEED AND 32767 (* AND ENSURE NUMBER IS POSITIVE *)
END ; (* OF RAND *)

BEGIN (* MAIN PROGRAM BEGINS HERE *)
SEED := 1 ;   (* USER MUST PREDEFINE A SEED *)
   FOR I := 0 TO 127 DO XARRAY(I) := 0 ; (* CLEAR COUNTERS *)
   FOR I := 1 TO 128*48 DO   (* PLOTS A NICE HISTOGRAM *)
      BEGIN
         J := RAND MOD 128 ; (* CREATE A RANDOM NUMBER *)
         XARRAY(J) := XARRAY(J)+1 ; (* INCR THE COUNTER *)
         PLOT(J,XARRAY(J),1)   (* PLOT THE POINT *)
      END
END.
```

Prime Number Generator Program

This program takes an array, FLAGS, initializes each element to 1, and marks all elements whose subscripts are multiples of 1, 2, 3, and so on. The remaining array elements are unmarked by default, and correspond to prime numbers. This algorithm is known as the Sieve of Eratosthenes. It runs slowly at first and picks up tremendous speed near the end. Prime numbers less than 8191 are printed.

```
CONST SIZE=8190 ; NUMITS=1 ; (* PRIME NUMBER PROGRAM *)
VAR FLAGS : ARRAY(SIZE) OF INTEGER ;
   I,PRIME,K,COUNT,ITER : INTEGER ;
BEGIN
   WRITE(NUMITS#,' ITERATIONS OF THE PROGRAM FOLLOW :',13) ;
   FOR ITER := 1 TO NUMITS DO
      BEGIN COUNT := 0 ; (* COUNTER OF # PRIMES CLEARED *)
            FOR I := 0 TO SIZE DO FLAGS(I) := 1 ; (* ALL FLAGS TRUE *)
            FOR I := 0 TO SIZE DO
               IF FLAGS(I) THEN
               BEGIN PRIME := I+I+3 ;
                     K := I+PRIME ;
                     WHILE K <= SIZE DO
                       BEGIN FLAGS(K) := 0 ;   (* FLAG A NON-PRIME *)
                             K := K+PRIME
                       END ;
               COUNT := COUNT +1 ; (* TALLY HOW MANY PRIMES GENERATED *)
               WRITE(PRIME#,' ')
               END ;
            WRITE(13,COUNT#,' PRIMES FOUND',13)
      END
END.   (* OF ERATOSTHENES' SIEVE *)
```

Trigonometry Functions Program

This program implements the SIN function scaled in amplitude by 32767. It is practical, because the SIN function normally returns a float-

ing-point number between -1 and $+1$. The Tiny Pascal version returns integers between -32767 and $+32767$.

The argument of the SIN function is given in degrees. The function begins by reducing the argument to between 0 and 90 degrees and keeping track of a possible minus sign in the answer. Samples of the SIN function are stored in the procedure for every 10-degree step. The argument is further resolved to lie within one of these 10-degree steps. Then, a straight-line approximation is made to compute the returned value.

A separate general-purpose interpolation function, INTER, has been included in the program for those who want to experiment. The left-hand point (X1,Y1) and the right-hand point (X2,Y2) are joined with a line segment. For the x-value given, INTER returns the corresponding y-value lying on the line segment.

```
VAR Z,I : INTEGER ; (* SINE & COSINE FUNCTION PROGRAM *)
FUNC INTER(X,X1,X2,Y1,Y2) ;    (* INTERPOLATION FUNCTION *)
BEGIN
   INTER := Y1 + (Y2-Y1) DIV (X2-X1) * (X-X1) ;
END ;  (* OF INTER *)

(* SIN(X) FUNCTION FOR ANY X. -32767 <= SIN <= 32767 *)
FUNC SIN(X) ;
CONST N=9    ;  (*  N+1= NUMBER OF FIXED INTER'N POINTS *)
VAR I,X1,X2,Y1,Y2,SIGN : INTEGER ;
    XARRAY             : ARRAY(N) OF INTEGER ;
BEGIN
   FOR I := 0 TO N DO XARRAY(I) := 10*I   ; (* SETUP XARRAY*)
   X := X MOD 360 ; (* REDUCE ARGUMENT TO UNIT CIRCLE *)
   SIGN := +1 ;     (* ASSUME 0TH QUADRANT FIRST OFF *)
   IF X < 0 THEN SIGN := -1 ; (* FOR -VE ARG'S *)
   X := ABS(X)    ; (* YES, -1 MOD 360 GIVES -1 !!*)
   I := X DIV  90 ; (* DETERMINE WHICH QUADRANT *)
   CASE I OF        (* ADJUST TO FIRST QUADRANT *)
0:   BEGIN    X := X       ;   SIGN := SIGN    END ;
1:   BEGIN    X := 180-X   ;   SIGN := SIGN    END ;
2:   BEGIN    X := X-180   ;   SIGN := -SIGN   END ;
3:   BEGIN    X := 360-X   ;   SIGN := -SIGN   END
   END ; (* OF CASE *)
   I := 1 ;     (* DETERMINE X'S PLACE IN XARRAY *)
   WHILE XARRAY(I) < X DO I := I+1 ;
   CASE I OF          (* DETERMINE INTERPOL'N POINTS *)
1:   BEGIN    Y1 := 00000   ;   Y2 := 05690   END ;
2:   BEGIN    Y1 := 05690   ;   Y2 := 11207   END ;
3:   BEGIN    Y1 := 11207   ;   Y2 := 16384   END ;
4:   BEGIN    Y1 := 16384   ;   Y2 := 21062   END ;
5:   BEGIN    Y1 := 21062   ;   Y2 := 25101   END ;
6:   BEGIN    Y1 := 25101   ;   Y2 := 28377   END ;
7:   BEGIN    Y1 := 28377   ;   Y2 := 30791   END ;
8:   BEGIN    Y1 := 30791   ;   Y2 := 32269   END ;
9:   BEGIN    Y1 := 32269   ;   Y2 := 32767   END
   END; (* OF CASE *)
    X1 := XARRAY(I-1) ;  (* LEFT SIDE OF INTERVAL *)
    X2 := XARRAY(I  ) ;  (* RIGHT SIDE OF INTERVAL *)
    SIN := SIGN * INTER(X,X1,X2,Y1,Y2) (* LINEAR INTERPOLATE *)
END; (* OF SIN *)

FUNC COS(X) ;   (* COSINE FUNCTION, REQUIRES SIN *)
BEGIN
```

Program continued

```
   COS := SIN(X+90)
END ; (* OF COS *)

BEGIN          (* MAIN USER PROGRAM BEGINS HERE *)
   Z := 1 ;
   WHILE Z <> 999 DO BEGIN
                     WRITE('ENTER Z ') ;
                     READ(Z#) ; (* ENTERING 999 STOPS PROGRAM *)
                     WRITE('SIN (',Z#,')=', SIN(Z)#,13,13) ;
                     END (* OF DO *)
END.   (* OF SIN FUNCTION DEMONSTATOR *)
```

The Exponential Function

In integer-based Tiny Pascal, the EXP function is limited to arguments from 0 to 10. Its value exceeds 32767 for arguments over 10 and is set to 0 for arguments less than 0. Consequently, a simple set of CASE statements is used to implement the EXP function.

```
(* EXPONENTIAL FUNCTION FOR RADIO SHACK TINY PASCAL *)
VAR X : INTEGER ; (* GLOBAL VARIABLE *)
FUNC EXP(T) ;
BEGIN
CASE T OF 00 : EXP := 00001 ; (* HANDLE THE GOOD ARGUMENTS *)
          01 : EXP := 00003 ;
          02 : EXP := 00007 ;
          03 : EXP := 00020 ;
          04 : EXP := 00055 ;
          05 : EXP := 00148 ;
          06 : EXP := 00403 ;
          07 : EXP := 01097 ;
          08 : EXP := 02981 ;
          09 : EXP := 08103 ;
          10 : EXP := 22027
          ELSE EXP := 32767       (* THIS IS THE OVERFLOW CASE *)
END (* OF CASE *);
IF  T<0   THEN EXP := 00000       (* RETURN 0 FOR MINUS INPUTS *)
END (* OF FUNCTION *) ;

BEGIN (* MAIN PROGRAM BEGINS HERE *)
X := 0 ;      (* DEFINE X SO THE DO-WHILE WILL BEHAVE PREDICTABLY *)
WHILE X <> 9999 DO     (* QUIT IF USER ENTER 9999 *)
  BEGIN  WRITE(' ENTER AN ARGUMENT ') ;
         READ(X#) ;
         WRITE('EXP(',X#,')=',EXP(X)#,13) ;
  END
END. (* OF EXPONENTIAL PROGRAM *)
```

Morse Code Speed Timing Program

Connect your Morse code keyer's tone output (or your shortwave radio receive output) to the cassette earphone input of the TRS-80, and run this program. It measures the code speed in words per minute (WPM) based on both the dit and the dah durations. You tell the program how many dits and dahs to count, up to 100. The program stores the duration of each dit and dah in an array. The array is then sorted (simple bubble sort) by the SORT procedure, and the procedure AVERAGE computes the average duration of dits and dahs combined. This results

in a first, crude estimate of the code speed. Next, the sorted array is searched from the beginning until the spot is found where the dahs begin. Two more code speed estimates are made—one based on just dits and one based on just dahs. The procedures DELAY, MARK, and SPACE are required to perform timing and detect the presence of dits and dahs (MARKS) and silence (SPACES). The program was tested on a 1.7 MHz machine.

This program was tested on a 32K machine and may not work on a 16K machine. Removing comments will help; use the TABs to align statements or eliminate them altogether. Note that the comments apply to the DELAY, SPACE, and MARK routines of the Morse code program.

```
VAR CODE,NUM,L,TEMP,AVG,J,TOTAL  : INTEGER; (* MORSE CODE WPM TESTER *)
    DITAVG,DAHAVG,THRESHOLD,S    : INTEGER; (* SUPPORT FUNCTIONS/PROCS *)
    X                            : ARRAY(100) OF INTEGER;
PROC DELAY(N);                  (* ADDS A LITTLE DELAY FOR TIMING *)
VAR K:INTEGER;
BEGIN K:=0; WHILE K<=N DO K:=K+1 END;

FUNC MARK;                        (* MEASURE DURATION OF MARK *)
VAR K:INTEGER;                    (* LOCAL INTEGER K *)
BEGIN
   K:=0;                          (* INITIALIZE MARK COUNTER *)
      REPEAT   OUTP(255,0);       (* CLEAR CASSETTE LATCH *)
             K:=K+1;              (* INCREMENT MARK COUNTER *)
            DELAY(1)              (* WAIT A LITTLE WHILE *)
        UNTIL (INP(255)=127);     (* EXIT IF BIT 7 STAYS OFF *)
MARK:=K                           (* RETURN VALUE OF MARK *)
END;  (* OF MARK *)

FUNC SPACE;                       (* MEASURE DURATION OF SPACES *)
VAR K:INTEGER;                    (* LOCAL COUNTER DIFFERENT FROM MARK *)
BEGIN
   K:=0;                          (* INITIALIZE SPACE COUNTER *)
      REPEAT OUTP(255,1);         (* KEEP TIMING SAME AS MARK *)
            K:=K+1;               (* INCREMENT SPACE COUNTER *)
            DELAY(1)              (* WAIT A LITTLE WHILE *)
        UNTIL (INP(255)=255);     (* TIL CASSETTE LATCH SEES SOMETHING *)
SPACE:=K                          (* RETURN VALUE OF SPACE *)
END;   (* OF SPACE *)

PROC SORT(START,STOP);  (* SORTS ARRAY X FROM LOW TO HIGH POINTS *)
VAR I,TEMP,II : INTEGER;   (* LOCAL VARIABLES *)
BEGIN         (* THE BUBBLE SORT *)
   FOR I:= START TO (STOP-1) DO
      FOR II:= 1 TO (STOP-1)-(I-1) DO
      BEGIN TEMP:=X(II);
            IF X(II+1)<X(II) THEN BEGIN X(II):=X(II+1);
                                        X(II+1):=TEMP
                                  END
      END
END;  (* OF SORT *)

FUNC AVERAGE(START,STOP); (* GIVES AVG OF X ARRAY FROM START TO STOP *)
VAR I,SUM :INTEGER;        (* LOCAL VARIABLES *)
BEGIN
   SUM:=0;                  (* INITIALIZE SUM TO ZERO *)
   FOR I:= START TO STOP DO SUM:=SUM+X(I); (* FORM THE SUM *)
   AVERAGE:= SUM DIV (STOP-START+1)        (* CALCULATE AVERAGE *)
END;  (* OF AVERAGE *)              (* END OF SUPPORT FOR WPM PROG *)
```

Program continued

```
BEGIN (* MAIN PROGRAM FOR MORSE CODE WPM MEASUREMENT *)
   WRITE('HOW MANY MARK SAMPLES ? ');READ(TOTAL#);
   IF TOTAL )100 THEN TOTAL:=100;  (* KEEP TOTAL LEGIT *)
   FOR J:=1 TO TOTAL DO BEGIN S:=SPACE; (* IGNORE SPACES *)(* GATHER *)
                              X(J):=MARK (* AND STORE MARKS *)(* DATA*)
                        END;
   FOR J:=1 TO TOTAL DO WRITE(X(J)#,9); (* PRINT RAW DATA *)
   WRITE(13,'========================================',13);
   READ(NUM); (* USER HIT KEY WHEN READY TO VIEW MORE DATA *)
   SORT(1,TOTAL); (* SORT THE ENTIRE ARRAY OF MEASUREMENTS *)
   AVG:=AVERAGE(1,TOTAL); (* COMPUTE GROSS AVERAGE WPM *)
   FOR J:=1 TO TOTAL DO WRITE(X(J)#,9); (* PRINT SORTED MARK DATA *)
   WRITE(13,'==========================================',13);
   READ(NUM); (* USER HIT KEY WHEN READY TO VIEW MORE DATA *)
   J:=0;
   REPEAT   J:=J+1  (* FIND WHERE THE MARKS START AND SPACES END *)
   UNTIL (    (X(J))AVG) OR (J)TOTAL)    );
   DITAVG:=AVERAGE(1,J-1);      (* AVERAGE LENGTH OF THE DITS *)
   DAHAVG:=AVERAGE(J,TOTAL);    (* AVERAGE LENGTH OF THE DAHS *)
   THRESHOLD:= (DITAVG+DAHAVG)DIV 2;  (* MIDWAY BETWEEN DITS AND DAHS *)
   WRITE(13);                   (* REPORT THE FINDINGS *)
   WRITE('AGGREGATE AVERAGE = ',AVG#,13);
   WRITE(' DIVIDING SUBSCRIPT IN X-ARRAY = ',J#,13);
   WRITE('DIT AVERAGE        = ',DITAVG#,13);
   WRITE('DAH AVERAGE        = ',DAHAVG#,13);
   WRITE('THRESHOLD          = ',THRESHOLD#,13);
   WRITE(' WPM BASED ON DITAVG = ', (234 DIV DITAVG)#,13);
   WRITE(' WPM BASED ON DAHAVG = ', (659 DIV DAHAVG)#,13);
END. (* OF MORSE CODE WPM MEASURING PROGRAM *)
```

Morse Code Reading Program (32K Needed)

This program reads the audio signals from the radio receiver at the black earphone input plug. No special electronics is needed. It decodes a fair range of code speeds without special modification.

The main program detects the longer silent period between letters in order to separate the dits and dahs that form letters. It counts the number of code elements (NUM) in a character and forms a binary number (CODE) consisting of zeros and ones. The zeros represent dits and the ones represent dahs.

Armed with NUM and CODE, the procedure DECODE scans its CASE statements to find the matching letter, digit, or punctuation mark. If a legal character is found, it is returned for printing. If there is a long period of silence, the program prints a blank and ceases printing until another character is received. An error causes a dollar sign to be printed.

It's easy to add more codes to the DECODE procedure. Simply find the CASE for the number of code elements, NUM, and add an extra CASE for the CODE of that new character. The less-than sign (<), for example, would be assigned the code . . -- (dit dit dah dah). There are NUM = 4 code elements. The binary code is 0011, so CODE = 3. The source program is edited as follows:

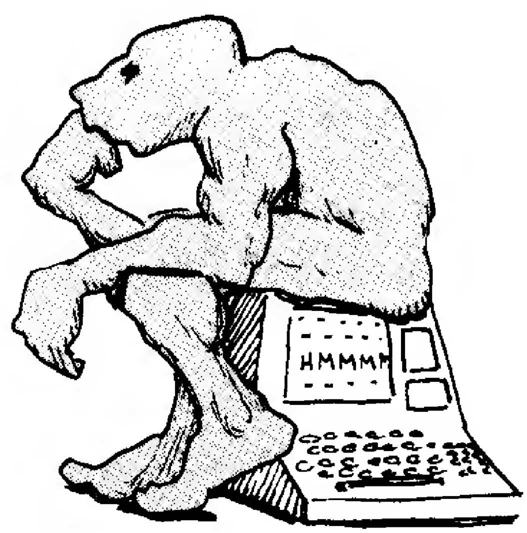
```
4: BEGIN
  CASE CODE OF
    0: L:="H" ; 1: L:="V" ; 2: L:="F" ; 3: L:="<" ;
```

The text of the Morse code decoder program follows:

```
VAR CODE,NUM,L,TEMP,LP : INTEGER; (* SUPPORT PROC'S FOR MORSE DECODER *)
                                  (* SEE WPM PROGRAM FOR INFO *)
PROC DELAY(N); (* CREATE A DELAY PROPORTIONAL TO N *)
VAR K:INTEGER;
BEGIN K:=0; WHILE K<=N DO K:=K+1 END;

FUNC MARK; (* RETURN DURATION OF MARKS (DITS/DAHS) *)
VAR K:INTEGER;
BEGIN
   K:=0;
      REPEAT   OUTP(255,0);
               K:=K+1;
               DELAY(1)
      UNTIL (INP(255)=127)OR(K>50); (* EXIT IF MARK TOO LONG *)
   MARK:=K
END;  (* OF MARK *)

FUNC SPACE; (* MEASURE DURATION OF SPACES BETWEEN THE MARKS *)
VAR K:INTEGER;
BEGIN
   K:=0;
      REPEAT OUTP(255,1);
             K:=K+1;
             DELAY(1)
      UNTIL (INP(255)=255)OR(K>50); (* EXIT IF SPACE TOO LONG *)
SPACE:=K
END;  (* OF SPACE *)


PROC DECODE; (* RETURNS CHARACTER IN GLOBAL L GIVEN NUM & CODE *)
BEGIN        (* SUPPORTS MORSE CODE DECODER PROGRAM *)
   CASE NUM OF
0: BEGIN L:=' ' END;             (* NO CODE ELEMENTS GIVEN *)
1: BEGIN                         (* ONE CODE ELEMENT GIVEN *)
      CASE CODE OF
         0: L:='E';    1: L:='T'
      END
   END;
2: BEGIN                         (* TWO CODE ELEMENTS GIVEN *)
      CASE CODE OF
         0: L:='I';    1: L:='A';    2: L:='N';    3: L:='M'
      END
   END;
3: BEGIN                         (* THREE CODE ELEMENTS GIVEN *)
      CASE CODE OF
         0: L:='S';    1: L:='U';    2: L:='R';    3: L:='W';
         4: L:='D';    5: L:='K';    6: L:='G';    7: L:='O'
      END
   END;
4: BEGIN                         (* FOUR CODE ELEMENTS GIVEN *)
      CASE CODE OF
         0: L:='H';    1: L:='V';    2: L:='F';
         4: L:='L';    6: L:='P';    7: L:='J';
         8: L:='B';    9: L:='X';   10: L:='C';   11: L:='Y';
        12: L:='Z';   13: L:='Q'
      END
   END;
5:    BEGIN                      (* FIVE CODE ELEMENTS GIVEN *)
         CASE CODE OF
            0: L:='5';    1: L:='4';    3: L:='3';    7: L:='2';
           15: L:='1';   16: L:='6';   24: L:='7';
           28: L:='8';   30: L:='9';   31: L:='0';   18: L:='/';
            10: BEGIN L:=' '; WRITE(' (END OF MESSAGE) ') END
         END
      END;
6:    BEGIN                      (* SIX CODE ELEMENTS GIVEN *)
```

Program continued

```
          CASE CODE OF
            12: L:='?';  21: L:='.';  33: L:='-';
            51: L:=','
          END
        END;
8:    BEGIN                         (* EIGHT CODE ELEMENTS GIVEN *)
          CASE CODE OF
             0: BEGIN L:=' ';WRITE(' (ERROR) ') END
          END
        END
END
END; (* OF DECODE PROCEDURE *)


BEGIN (* MORSE CODE DECODER MAIN PROGRAM BEGINS *)
REPEAT
   CODE:=0 ; NUM:=0 ; LP:=L ; L:='$';
   WHILE SPACE<=20 DO
      BEGIN   TEMP:=MARK;
              IF (TEMP>=20)AND(TEMP<50)
              THEN CODE:= 1+(CODE SHL 1) ELSE CODE:=CODE SHL 1;
              NUM:=NUM+1
      END;
   DECODE;
   IF (LP=' ')AND(L=' ') THEN ELSE WRITE(L) ; LP:=L
UNTIL 1=2     (* LOOP FOREVER *)
END. (* OF MORSE CODE DECODER PROGRAM *)
```



11

Beginning Scrolling

by Roger B. Wilcox

System Requirements:
Model I
16K RAM
Disk BASIC

You don't have to have an assembler or much experience to use this assembly-language program (see Figure 1). It combines a program by Roger Fuller to scroll a window of lines up and down (*80 Microcomputing*, January 1982, p. 30), and a program by M. Keller to scroll a number of lines down while protecting the top and bottom lines (*80 Microcomputing*, February 1982, p. 264).

This program lets you scroll forward and backward through long lists of data, using screen lines 3 through 14, while headings or instructions are protected on the top and bottom lines. It has two entry points, called by USR0 and USR1. There is one exit point, at the end. Let's look at the part of the program that moves the lines on the screen up (USR1 section of the Program Listing).

The key machine-language instruction is LDIR, and this section of the program is built around it. LDIR moves a byte of data from the HL register pair to the DE register pair, and checks to see if register pair BC is zero. If not, BC is decremented, and HL and DE are incremented. This sequence repeats until BC is zero. LDIR acts like a single instruction FOR-NEXT loop, using the BC, HL, and DE register pairs.

If HL has the starting address of a line in video memory, DE has the starting address of the next line up, and BC is initialized to the number of bytes to move (11 lines=704). You can see how LDIR begins with the first line and moves it byte-by-byte up to the next line. LDIR automatically sets itself up to transfer the next line, and continues to drop down through the lines on the screen until BC=0 at the end of screen line 14.

DATA	MNEMONIC	REMARKS
	**** MOVE DOWN, USR0 ****	
33,63,63	LD HL,16191	End of line 13
17,127,63	LD DE,16255	End of line 14
1,192,2	LD BC,704	Number bytes to move
237,184	LDDR	Move lines down
35	INC HL	Get start of top line
24,13	JR 13 (ERASE)	Erase top line
	**** MOVE UP, USR1 ****	
33,192,60	LD HL,15552	Start of line 4
17,128,60	LD DE,15488	Start of line 3
1,192,2	LD BC,704	Number bytes to move
237,176	LDIR	Move lines up
213	PUSH DE	Put DE in stack
225	POP HL	HL=DE
	**** ERASE ****	
62,32 (ERASE)	LD A," "	Load A with space
6,64	LD B,64	Number bytes to clear
119 (LOOP)	LD (HL),A	Clear one byte
35	INC HL	Next byte
16,252	DJNZ −4 (LOOP)	Loop until B=0
201	RET	Return to BASIC

Figure 1

The program begins by initializing HL, DE, and BC for use by the LDIR instruction. (*Initialization* means to establish a starting value.) This is done with the mnemonic LD dd,nn, where dd represents a register pair, and nn is the least significant byte (LSB) and most significant byte (MSB) of the number (video memory address, in this case). The Z80 code listing shows the format for this instruction as 00dd0001,n,n. The binary value of dd varies from 0 (00) to 3 (11) as follows: 0=BC, 1=DE, 2=HL, 3=SP. For HL the binary part of the format becomes 00100001, which is decimal 33 from the conversion table.

The BASIC program uses line 1 as a protected line, and line 2 is reserved as a space, so line 3 is the top of the scrolling lines. Line 4 is the first line to be moved up. Video memory starts at decimal address 15360, and line 4 starts at 15552 (15360+3*64), which converts to LSB=192 and MSB=60. Therefore, the data representing the first instruction of this section of the program is 33, 192, 60. This procedure is repeated for LD DE, 15488 (the starting address of line 3, the next line up) and for LD BC, 704.

Initialization complete, the next instruction is LDIR, represented by decimal 237, 176. When this section of the program is called by a USR1 statement, 11 lines on the screen (4–14) are moved up one-by-one. The bottom scrolling line must be erased to provide a clean space to print the next line of data from BASIC. Either LD (DE),A or LD (HL),r can be used to clear the last line, but here I chose LD (HL),r. After the last LDIR in-

crementing of DE, DE contains the starting address of line 14, which is to be erased using HL. A quick way to transfer this address to HL is to PUSH the value in DE into the stack and then POP it back into HL.

The erase operation loads register A with a space (ASCII code 32), then loads the HL address with the contents of A. Register B is used for a byte counter by loading it with the number of bytes to clear (one line equals 64 bytes).

The B register is used for the counter because the DJNZ e instruction used for the loop (like GOTO in BASIC) checks B for a non-zero status, and also decrements B, before performing a relative jump. The value of e is the number of bytes to jump, and requires an explanation. In this case, you want to jump backward in the code to the start of the LD (HL),A instruction. Counting the number of bytes to jump involves the program counter (PC). After an instruction is read, the PC has the address of the byte *after* the instruction. Relative jumps are counted from this byte, to the first byte of the target instruction. Here, it is a jump of four bytes. Since this is a backward jump, the value is a negative number. Negative numbers in assembly language must be represented by their two's complement. In simple terms that means that $255 = -1$, $254 = -2$, etc. The -4 becomes $256 - 4 = 252$, and the data values for DJNZ -4 are 16, 252.

Just prior to the loop, HL is incremented, so the next byte is cleared each time the loop is performed. At this point, 11 lines of the screen have been moved up one line and the last line has been erased. A RET instruction returns control to the BASIC program.

The (earlier) section of the program that moves lines down is called by USR0. It is similar to the move-up routine, except that LDDR does the moving instead of LDIR. The difference is that LDDR decrements HL and DE. Therefore, the screen address used to initialize HL and DE must be the end of the lines. Line 16 is a protected line, and line 15 is a space between the scrolling lines and the bottom. Line 13 is the first to move down (to line 14). The starting address of line 13 is $15360 + 12 * 64 = 16128$, and the end of line 13 is $16128 + 63 = 16191$, which is loaded into HL. Register pair DE, for line 14, is handled in a similar manner. BC is loaded again with the number of bytes in 11 lines (704).

After the last LDDR decrement ($BC = 0$), HL has the address of the end of line 2, which is above the scrolling line. Incrementing HL moves it down to the starting address of the top scrolling line (line 3), so that it can be cleared. Since the erase routine uses HL to clear a line, it services both the move-up and move-down sections of the program.

This program listing can be incorporated into other programs, and modified if necessary. As long as there is a blank line above and below the scrolling lines, the ERASE routine can be deleted; make the number of bytes to be moved equal to 12 lines (768 bytes), and the blank line is moved to clear the last scrolling line. The RET instruction replaces the

LD A,"" instruction. The INC HL and PUSH/POP are no longer needed, and the 2-byte JR 13 can be replaced by a 1-byte RET. With these modifications you should end up with a 24-byte assembly program. Change the POKE limits in the BASIC program to agree with the number of bytes.

Program Listing

```
5 '*** SCROLL UP AND DOWN WITH PROTECTED LINES TOP & BOTTOM
10 POKE16561,87:POKE16562,127 '*** SET MEMORY SIZE TO 32599
20 CLEAR1000:DIM PA$(26):CLS
30 FORX=32600TO32635:READJ:POKEX,J:NEXT
40 DATA 33,63,63,17,127,63,1,192,2,237,184,35,24,13
50 DATA 33,192,60,17,128,60,1,192,2,237,176,213,225
60 DATA 62,32,6,64,119,35,16,252,201
70 DEFUSR0=32600:DEFUSR1=32614:DEFINT K,L,X:KA=14400
72 '****************
74 '*  THE PROGRAM THAT CREATES THE DATA TO BE SCROLLED
76 '*  GOES IN THIS AREA.  LINE 80 IS A DEMO PROGRAM.
80 FORX=1TO26:PA$(X)=STRING$(10,64+X):NEXT
82 '*  CHANGE LINES 90 AND 100 TO MATCH YOUR PROGRAM NEEDS.
84 '*  CHANGE PN TO EQUAL NUMBER OF DATA LINES.
86 '****************
90 PRINT@960,"PRESS: <[> TO SCROLL UP; <"CHR$(92)"> TO SCROLL DO
WN; <CLEAR> FOR MENU";
100 PRINT@0,"                    ITEM  NO.         DATA":PRINT
110 FORX=1TO12:PRINTTAB(20)X,PA$(X):NEXT
120 LE=12:LT=1:PN=26
130 K=PEEK(KA):IF K=8 AND LT>1 THEN LT=LT-1:LE=LE-1:PRINT@USR0(1
48),LT,PA$(LT);
140 IF K=16 AND LE<PN THEN LE=LE+1:LT=LT+1:PRINT@USR1(852),LE,PA
$(LE);
150 IF K=2 THEN CLS:STOP '*** REPLACE WITH RETURN TO MENU, ETC.
160 GOTO130
```

12

Line Drawing

by Daniel Lindsey

System Requirements:
Level II or Disk BASIC
Model I or III
16K RAM
Editor/assembler

BASIC is too slow for games with graphics. Level II BASIC is flexible, but falls short when high-speed drawing is required. The STRING$ function helps, but plots only horizontal lines.

There are ways around this problem. You can buy a BASIC compiler to convert programs into machine code, but this is expensive. You can suffer with BASIC, or you can write an assembly-language routine to draw lines, accessing it through the USR(n) function from BASIC.

Operation

Program Listing 1 draws a line between any two points on the screen given the (x,y) coordinates of both points. Program operation is easier to follow from the algorithm, outlining the flow of the program in non-computer language (Figure 1).

To understand the program's operation, divide it into four sections: the BASIC interface, the slope calculator, the x- or y-plot setup, and the plot routine.

The BASIC interface links the BASIC program to the plot subroutine. It compares the number received from the USR call to the known command numbers, jumping to whatever routine is requested, or returning on an illegal command.

Before calling the plot subroutine, each routine sets a flag signalling the set routine to erase or draw. If the command is a table operation, the program moves a pointer through the table of coordinates, drawing or

erasing lines. The BASIC interface provides the necessary functions that use the plot subroutine from a BASIC program.

The slope of a line is the ratio between the change in y- and x-coordinates. Multiplying the slope of a line by an x-coordinate results in its corresponding y-coordinate. This lets the plot routine produce the x- and y-coordinates along the requested line. However, as the line approaches vertical, the slope approaches an infinite value. If the line is at an angle greater than 45 degrees, the routine switches the axis along which it counts.

The slope calculator gathers the necessary values, then generates the slope of the requested line. Since this is the entry point of the plot subroutine, the routine clears the temporary storage area. It then collects the two x-coordinates from the table and solves for the change in x. After doing the same for the y-coordinates, the routine compares the change in x with the change in y. If the change in y is greater than the change in x, then the angle of the line is greater than 45 degrees from the x-axis, and the routine must plot along the y-axis to avoid a slope that is greater than one. Once the routine has branched on a y-plot or continued on an x-plot, the registers are loaded with the change in x and the change in y, and the division subroutine is called to calculate the slope. The slope calculator produces a slope and the axis from which it was taken.

Figure 1. *Plot Algorithm*

```
BASIC INTERFACE
1. Find n of USR(n)
2. Cases—If:
   n=0  then (line draw)
          set flag to draw mode
          jump to draw program
   n=1  then (line erase)
          set flag to erase mode
          jump to draw program
   n=2  then (table draw)
          point to table of coordinates
          set flag to draw mode
          Until second x-coordinate is greater than 127
                call draw program (as a subroutine)
                move pointer down through the table
          End Until
          return to BASIC
   n=3  then (table erase)
          point to table of coordinates
          set flag to erase mode
          Until second x-coordinate is greater than 127
                call draw program (as a subroutine)
                move pointer down through the table
          End Until
   End Cases
```

SLOPE CALCULATOR

```
1. Clear storage area
2. Calculate the change in x-coordinates
3. Calculate the change in y-coordinates
4. If the change in y is greater than the change in x
        (plot along the y-axis)
        calculate slope: change in x/change in y
        jump to plot setup (y-plot)
   Else:
        (plot along x-axis)
        calculate slope: change in y/change in x
        jump to plot setup (x-plot)
```

Y-PLOT SETUP

```
1. Load the counter with the smaller y (starting count)
2. Load memory with the larger y (final count)
3. If the starting count x-coordinate is greater than the final count x-coordinate then
        signal a negative slope
        Else
             signal a positive slope
4. Jump to plot section
```

X-PLOT SETUP

```
1. Load the count with the smaller x (starting count)
2. Load memory with the larger x (final count)
3. If the starting count y-coordinate is greater than the final count y-coordinate, then
        signal a negative slope
   Else
        signal a positive slope
4. Jump to plot section
```

PLOT

```
1. While count is less than or equal to final count:
        If plot flag is equal to x-plot then,
             load the HL registers with the (x,y) coordinates
   Else
        load the HL registers with the (y,x) coordinates
   End If (the (x,y) coordinates are the starting count and the current alternate count,
        which was set to a starting value in the setup section)
   Call set subroutine to light pixel
   If angle of line is 45 degrees then
        If slope of the line is negative then
             decrement alternate count
        Else
             increment alternate count
   Else
        If the line's slope is negative then
             add the two's complement of the slope to the alternate count
        Else
             add the slope of the line to the alternate count
        End If
        Increment count
   End While
```

The x- or y-plot setup initializes the registers and memory necessary for the plot routine to generate the x- and y-coordinates between the two given points. The x- and y-plot routines work the same way. The only difference is that the x- and y-coordinates are switched. The x-plot routine compares the two x-coordinates, storing the larger as a final count in temporary storage, and the smaller as an initial count in the C register. The y-coordinate that corresponds to the initial count is stored in the D register as an initial y. The DE register pair stores the y-coordinate corresponding to the larger x-coordinate.

The D register contains the integer y-count, and the E register contains the decimal portion of the y-count. The routine compares the initial and final y, signalling a negative or positive slope in the temporary storage area. The routine signals an x-plot in the temporary storage, saves the slope in the B register, and passes control to the plot routine. The x- or y-plot setup prepares all values needed by the plot routine to generate a line.

The plot routine uses the information gathered by the previous sections to generate all the x- and y-coordinates between the two given points. Depending on the flag set in one of the setup routines, this routine counts along an axis from the smallest x or y to the largest x or y. As the program loops through the routine, the slope in the B register is added to the alternate coordinate in the DE register pair. The current (x,y) coordinates are sent to the set subroutine through each loop of the plot routine. In the case of a 45-degree angle line (slope equals one), the count is incremented, and the alternate coordinate is either incremented or decremented, depending on the sign (plus or minus) of the slope. Once the line has been plotted, control is returned to either BASIC or the BASIC interface. The plot routine generates the actual values of the x- and y-coordinates between the given points, setting pixels (picture elements) as it loops through the routine.

Using the Routines

After making a machine-readable copy of the program, you are ready to start using the line subroutine in your computer. Always set memory size to 32000 before loading the program.

Before you can draw a line, you must store the coordinates of the end points of the line in memory. Simply POKE the first x in 32436, its corresponding y in 32437, the second x in 32438, and its corresponding y in 32439.

Once the coordinates are in memory you can erase or draw a line. To draw a line use USR(0), and to erase a line use USR(1). For example, to plot a line diagonally on the screen, POKE 0 into 32436 and 32437, POKE 127 into 32438, POKE 47 into 32439, and type M=USR(0). A white line will instantly appear from the upper left corner to the lower right corner of the screen.

While the line functions serve many useful purposes, many applications require figures with more than one line. The table draw functions (draw and erase) solve this problem.

They are similar to the line functions with one exception. The line functions draw only one line, while the table functions draw as many lines (connected) as the table can hold. The following example will help you understand the operation of the table functions.

Location	**Value**
32436	0
32437	0
32438	127
32439	0
32440	127
32441	47
32442	0
32443	47
32444	0
32445	0
32446	255

Figure 2

To draw a border, place the numbers shown in Figure 2 into the indicated memory locations. After these values are in memory, USR(2) will draw the border, and USR(3) will erase it. To build a table, simply place the (x,y) coordinates of the points in the order they are to be drawn in ascending memory. Terminate the list with a number greater than 127.

Using these functions, you should be able to draw lines at an average speed of 50 lines per second. This greatly reduces the time that it takes for a program to set up a screen. Try the examples in Program Listings 2 and 3.

This program is designed for a cassette-based Model I or III machine. Both Level II and Model III BASIC require the starting address of any machine-language subroutines to be stored in memory addresses 16526 and 16527. The usual approach is to POKE the correct values in from the BASIC program and then do a USR(n) to call the machine-language routine. This program takes a different approach: lines 280 and 290 of the assembly-language routine take care of loading the correct value, 7D00H (32000 decimal) into locations 16526 and 16527.

Program Listing 1

```
00100 ;
00110 ;                  * LINE DRAW *
00120 ;
00130 ; By Daniel Lindsey (1/1/81) (C)
```

Program continued

```
               ØØ14Ø ;
               ØØ15Ø ;        This program draws a graphics line between any
               ØØ16Ø ; two points on the screen; given the (X,Y) coordinates
               ØØ17Ø ; of both points.
               ØØ18Ø ;
               ØØ19Ø ;        Conmands:
               ØØ2ØØ ;
               ØØ21Ø ; USR(Ø)-Draw a single line
               ØØ22Ø ; USR(1)-Erase a single line
               ØØ23Ø ; USR(2)-Draw a set of lines from a table
               ØØ24Ø ; USR(3)-Erase a set of line from a table
               ØØ25Ø ;
               ØØ26Ø ;        *** BASIC INTERFACE ***
               ØØ27Ø ;
4Ø8E           ØØ28Ø          ORG     16526
4Ø8E ØØ7D      ØØ29Ø          DEFW    BEGIN           ;Define entry-USR call
7DØØ           ØØ3ØØ          ORG     7DØØH           ;Actual start of program
7DØØ CD7FØA    ØØ31Ø BEGIN    CALL    ØA7FH           ;Get N of USR(N)
7DØ3 7D        ØØ32Ø          LD      A,L             ;Value of N
7DØ4 FEØØ      ØØ33Ø          CP      Ø               ;Check for draw
7DØ6 2815      ØØ34Ø          JR      Z,DRAW          ;Jump if draw
7DØ8 FEØ1      ØØ35Ø          CP      1               ;Check for erase
7DØA 28Ø9      ØØ36Ø          JR      Z,ERASE         ;Jump if erase
7DØC FEØ2      ØØ37Ø          CP      2               ;Check for table draw
7DØE 2815      ØØ38Ø          JR      Z,TDRAW         ;Jump if table draw
7D1Ø FEØ3      ØØ39Ø          CP      3               ;Check for table erase
7D12 2829      ØØ4ØØ          JR      Z,TERASE        ;Jump if table erase
7D14 C9        ØØ41Ø          RET                     ;Return to BASIC
7D15 21B37E    ØØ42Ø ERASE    LD      HL,ESTOR        ;Pointer to flag
7D18 36ØØ      ØØ43Ø          LD      (HL),Ø          ;Set flag to erase
7D1A C3557D    ØØ44Ø          JP      START           ;Go erase line
7D1D 21B37E    ØØ45Ø DRAW     LD      HL,ESTOR        ;Pointer to flag
7D2Ø 36Ø1      ØØ46Ø          LD      (HL),1          ;Set flag to draw
7D22 C3557D    ØØ47Ø          JP      START           ;Go draw line
7D25 FD21B47E  ØØ48Ø TDRAW    LD      IY,TABLE        ;Point to coordinates
7D29 21B37E    ØØ49Ø          LD      HL,ESTOR        ;Point to flag
7D2C 36Ø1      ØØ5ØØ          LD      (HL),1          ;Set flag to draw
7D2E FDCBØ27E  ØØ51Ø TD1      BIT     7,(IY+2)        ;Second X coordinate
7D32 CØ        ØØ52Ø          RET     NZ              ;Return if X>127
7D33 CD597D    ØØ53Ø          CALL    START2          ;Draw line
7D36 FD23      ØØ54Ø          INC     IY              ;Move pointer through
7D38 FD23      ØØ55Ø          INC     IY              ;   the table
7D3A C32E7D    ØØ56Ø          JP      TD1             ;Jump to top of loop
7D3D FD21B47E  ØØ57Ø TERASE   LD      IY,TABLE        ;Point to Coordinates
7D41 21B37E    ØØ58Ø          LD      HL,ESTOR        ;Point to flag
7D44 36ØØ      ØØ59Ø          LD      (HL),Ø          ;Set flag to erase
7D46 FDCBØ27E  ØØ6ØØ TE1      BIT     7,(IY+2)        ;Second X coordinate
7D4A CØ        ØØ61Ø          RET     NZ              ;Return if X>127
7D4B CD597D    ØØ62Ø          CALL    START2          ;Erase line
7D4E FD23      ØØ63Ø          INC     IY              ;Move pointer through
7D5Ø FD23      ØØ64Ø          INC     IY              ;   the table
7D52 C32E7D    ØØ65Ø          JP      TD1             ;Jump to top of loop
               ØØ66Ø ;
               ØØ67Ø ;        *** END OF BASIC INTERFACE ***
               ØØ68Ø ;
               ØØ69Ø ;        *** SLOPE CALCULATOR ***
               ØØ7ØØ ;
7D55 FD21B47E  ØØ71Ø START    LD      IY,TABLE        ;Pointer in table
7D59 DD21B17E  ØØ72Ø START2   LD      IX,STORE        ;Pointer in temp. storage
7D5D AF        ØØ73Ø          XOR     A               ;Clear A
7D5E DD77ØØ    ØØ74Ø          LD      (IX+Ø),A        ;Set storage area to zero
```

```
7D61 DD77Ø1     ØØ75Ø         LD      (IX+1),A
7D64 FD56ØØ     ØØ76Ø         LD      D,(IY+Ø)       ;Load in X coordinates
7D67 FD7EØ2     ØØ77Ø         LD      A,(IY+2)
7D6A 92         ØØ78Ø         SUB     D              ;Find change in X's
7D6B F27Ø7D     ØØ79Ø         JP      P,CONT1        ;Jump if positive
7D6E ED44       ØØ8ØØ         NEG                    ;Change to positive value
7D7Ø 57         ØØ81Ø CONT1   LD      D,A            ;Save change in X's
7D71 FD5EØ1     ØØ82Ø         LD      E,(IY+1)       ;Load in Y coordinates
7D74 FD7EØ3     ØØ83Ø         LD      A,(IY+3)
7D77 93         ØØ84Ø         SUB     E              ;Find the change in Y's
7D78 F27D7D     ØØ85Ø         JP      P,CONT2        ;Jump if result positive
7D7B ED44       ØØ86Ø         NEG                    ;Change to positive value
7D7D 5F         ØØ87Ø CONT2   LD      E,A            ;Save change in Y's
7D7E 92         ØØ88Ø         SUB     D              ;Find change in Y's-X's
7D7F F28A7D     ØØ89Ø         JP      P,CONT3        ;Jump if slope positive
7D82 4B         ØØ9ØØ         LD      C,E            ;Setup for divide routine
7D83 62         ØØ91Ø         LD      H,D            ;   X's/Y's
7D84 CD437E     ØØ92Ø         CALL    DIV            ;Calculate slope
7D87 C3927D     ØØ93Ø         JP      XPLOT          ;Jump to next section
7D8A 63         ØØ94Ø CONT3   LD      H,E
7D8B 4A         ØØ95Ø         LD      C,D
7D8C CD437E     ØØ96Ø         CALL    DIV
7D8F C3C67D     ØØ97Ø         JP      YPLOT
                ØØ98Ø ;
                ØØ99Ø ;       *** END OF SLOPE CALCULATOR ***
                Ø1ØØØ ;
                Ø1Ø1Ø ;       *** SETUP FOR PLOT ROUTINE ***
                Ø1Ø2Ø ;
7D92 FD7EØØ     Ø1Ø3Ø XPLOT   LD      A,(IY+Ø)       ;Load in the X's
7D95 FD46Ø2     Ø1Ø4Ø         LD      B,(IY+2)
7D98 B8         Ø1Ø5Ø         CP      B              ;Compare X's
7D99 F2A97D     Ø1Ø6Ø         JP      P,XP1          ;Jump if A>=B
7D9C 4F         Ø1Ø7Ø         LD      C,A            ;Save starting count
7D9D DD7ØØØ     Ø1Ø8Ø         LD      (IX+Ø),B       ;Save final count
7DAØ FD7EØ1     Ø1Ø9Ø         LD      A,(IY+1)       ;Load in the Y's
7DA3 FD66Ø3     Ø11ØØ         LD      H,(IY+3)
7DA6 C3B37D     Ø111Ø         JP      XP2            ;Continue @ XP2
7DA9 48         Ø112Ø XP1     LD      C,B            ;Save starting count
7DAA DD77ØØ     Ø113Ø         LD      (IX+Ø),A       ;Save final count
7DAD FD7EØ3     Ø114Ø         LD      A,(IY+3)       ;Load in the Y's
7DBØ FD66Ø1     Ø115Ø         LD      H,(IY+1)
7DB3 57         Ø116Ø XP2     LD      D,A            ;Save initial Y
7DB4 1EØØ       Ø117Ø         LD      E,Ø            ;Clear E
7DB6 DDCBØ1CE   Ø118Ø         SET     1,(IX+1)       ;Signal XPLOT
7DBA BC         Ø119Ø         CP      H              ;Compare the Y's
7DBB FAC27D     Ø12ØØ         JP      M,XP3          ;Jump if slope positive
7DBE DDCBØ1D6   Ø121Ø         SET     2,(IX+1)       ;Signal negative slope
7DC2 45         Ø122Ø XP3     LD      B,L            ;Save slope
7DC3 C3F77D     Ø123Ø         JP      PLOT           ;Continue @ PLOT
7DC6 FD7EØ1     Ø124Ø YPLOT   LD      A,(IY+1)       ;Load in the Y's
7DC9 FD46Ø3     Ø125Ø         LD      B,(IY+3)
7DCC B8         Ø126Ø         CP      B              ;Compare the Y's
7DCD F2DD7D     Ø127Ø         JP      P,YP1          ;Jump if A>B
7DDØ 4F         Ø128Ø         LD      C,A            ;Save starting count
7DD1 DD7ØØØ     Ø129Ø         LD      (IX+Ø),B       ;Save final count
7DD4 FD7EØØ     Ø13ØØ         LD      A,(IY+Ø)       ;Load in the X's
7DD7 FD66Ø2     Ø131Ø         LD      H,(IY+2)
7DDA C3E77D     Ø132Ø         JP      YP2            ;Continue @ YP2
7DDD 48         Ø133Ø YP1     LD      C,B            ;Save starting count
7DDE DD77ØØ     Ø134Ø         LD      (IX+Ø),A       ;Save final count
7DE1 FD7EØ2     Ø135Ø         LD      A,(IY+2)       ;Load in the X's
```

Program continued

```
7DE4 FD66ØØ                  LD      H,(IY+Ø)
7DE7 57              YP2     LD      D,A           ;Save the intial X
7DE8 1EØØ                    LD      E,Ø           ;Clear E
7DEA DDCBØ18E                RES     1,(IX+1)      ;Signal YPLOT
7DEE BC                      CP      H             ;Check for negative slope
7DEF FAF67D                  JP      M,YP3         ;Jump if slope positive
7DF2 DDCBØ1D6                SET     2,(IX+1)      ;Signal a negative slope
7DF6 45              YP3     LD      B,L           ;Save slope
                     ;
                     ;       *** END OF SETUP FOR PLOT ***
                     ;
                     ;       *** PLOT ***
                     ;
7DF7 79              PLOT    LD      A,C           ;Get current count
7DF8 DDBEØØ                  CP      (IX+Ø)        ;Compare with final count
7DFB 28Ø1                    JR      Z,PL1         ;Jump if last loop
7DFD FØ                      RET     P             ;RETURN TO BASIC !
7DFE DDCBØ14E        PL1     BIT     1,(IX+1)      ;1-XPLOT Ø-YPLOT
7EØ2 28Ø5                    JR      Z,PL2         ;Jump on YPLOT
7EØ4 61                      LD      H,C           ;Load HL with X,Y
7EØ5 6A                      LD      L,D           ;   coordinates for XPLOT
7EØ6 C3ØB7E                  JP      PL3           ;Continue @ PL3
7EØ9 69              PL2     LD      L,C           ;Load HL with X,Y
7EØA 62                      LD      H,D           ;   coordinates for YPLOT
7EØB E5              PL3     PUSH    HL            ;Save coordinates
7EØC D9                      EXX                   ;Swap registers
7EØD E1                      POP     HL            ;Restore coordinates
7EØE CD5F7E                  CALL    SET           ;Set point
7E11 D9                      EXX                   ;Restore registers
7E12 DD21B17E                LD      IX,STORE      ;Restore pointer
7E16 DDCBØ15E                BIT     3,(IX+1)      ;Ø-ANGLE/NOT45,1-ANGLE 45
7E1A 28ØF                    JR      Z,PL6         ;Jump if angle not 45
7E1C DDCBØ156                BIT     2,(IX+1)      ;Ø-pos. 1-negative slope
7E2Ø 28Ø4                    JR      Z,PL4         ;Jump if slope positive
7E22 15                      DEC     D             ;Coordinate - 1
7E23 C3277E                  JP      PL5           ;Continue @ PL5
7E26 14              PL4     INC     D             ;Coordinate + 1
7E27 ØC              PL5     INC     C             ;Count=Count+1
7E28 C3F77D                  JP      PLOT          ;Jump to top of loop
7E2B DDCBØ156        PL6     BIT     2,(IX+1)      ;Ø-pos. 1-negative slope
7E2F 28Ø9                    JR      Z,PL7         ;Jump if slope positive
7E31 26FF                    LD      H,255         ;Set all bits in H
7E33 78                      LD      A,B           ;Load with slope
7E34 2F                      CPL                   ;Complement
7E35 6F                      LD      L,A           ;HL has 2's complement
7E36 23                      INC     HL            ;Complete 2's complement
7E37 C33D7E                  JP      PL8           ;Go add negative slope
7E3A 26ØØ            PL7     LD      H,Ø           ;Clear H
7E3C 68                      LD      L,B           ;Positive slope in HL
7E3D 19              PL8     ADD     HL,DE         ;Add slope to count
7E3E EB                      EX      DE,HL         ;Store result in DE
7E3F ØC                      INC     C             ;Add one to count
7E4Ø C3F77D                  JP      PLOT          ;Jump to top of loop
                     ;
                     ;       *** END OF PLOT SECTION ***
                     ;
                     ;       *** SUBROUTINE DIVIDE ***
                     ;
7E43 7C              DIV     LD      A,H           ;Check for 45 deg. angle
7E44 91                      SUB     C             ;   & Jump if not 45
7E45 2ØØ5                    JR      NZ,DV1        ;
```

```
7E47 DDCB01DE 01970         SET    3,(IX+1)      ;Signal a 45 deg. angle
7E4B C9       01980         RET                  ;Return to prog.
7E4C 2E00     01990 DV1     LD     L,0           ;Clear result
7E4E 0609     02000         LD     B,9           ;Number of loops
7E50 CB25     02010 DV2     SLA    L             ;Shift result
7E52 79       02020         LD     A,C           ;Get D2
7E53 94       02030         SUB    H             ;Subtract D1
7E54 FA5A7E   02040         JP     M,DV3         ;Jump if not positive
7E57 4F       02050         LD     C,A           ;Update D2
7E58 CBC5     02060         SET    0,L           ;Set bit in result
7E5A CB21     02070 DV3     SLA    C             ;Shift D2 left
7E5C 10F2     02080         DJNZ   DV2           ;Loop untill done
7E5E C9       02090         RET                  ;Return to prog.
              02100 ;
              02110 ;       *** END OF DIVIDE ***
              02120 ;
              02130 ;       *** SUBROUTINE SET ***
              02140 ; By William Barden, 80-MICROCOMPUTING, JUNE 1980, PG.24
              02150 ;
7E5F 5C       02160 SET     LD     E,H           ;X
7E60 7D       02170         LD     A,L           ;Y
7E61 CB3B     02180         SRL    E             ;Get char position in E
7E63 1600     02190         LD     D,0           ;Set COL# to 0
7E65 3001     02200         JR     NC,SET10      ;Go if COL#=0
7E67 14       02210         INC    D             ;COL#=1
7E68 06FF     02220 SET10   LD     B,0FFH        ;-1 to B
7E6A 04       02230 SET20   INC    B             ;Bump quotient in B=LINE#
7E6B D603     02240         SUB    3             ;Successive subt. for /3
7E6D F26A7E   02250         JP     P,SET20       ;Go if not negative
7E70 C603     02260         ADD    A,3           ;Add back for remainder
7E72 07       02270         RLCA                 ;(ROW#)*2
7E73 82       02280         ADD    A,D           ;(ROW#)*2+COL#=BIT POS.
7E74 4F       02290         LD     C,A           ;Save BIT POS. in C
7E75 68       02300         LD     L,B           ;Line #
7E76 2600     02310         LD     H,0           ;Now in HL
7E78 0606     02320         LD     B,6           ;Shift count
7E7A 29       02330 SET30   ADD    HL,HL         ;Multiply LINE#*64
7E7B 10FD     02340         DJNZ   SET30         ;Loop till done
7E7D 1600     02350         LD     D,0           ;DE now has CHAR POS.
7E7F 19       02360         ADD    HL,DE         ;LINE#*64+CHARPOS. in HL
7E80 11003C   02370         LD     DE,3C00H      ;Start of video
7E83 19       02380         ADD    HL,DE         ;Points to memory
7E84 0600     02390         LD     B,0           ;BC now has bit pos.
7E86 DD21AB7E 02400         LD     IX,MASK       ;Start of mask table
7E8A DD09     02410         ADD    IX,BC         ;Point to mask
7E8C 7E       02420         LD     A,(HL)        ;Load pixel
7E8D CB7F     02430         BIT    7,A           ;Check for graphics
7E8F 2002     02440         JR     NZ,SET40      ;Jump if graphics
7E91 3E80     02450         LD     A,128         ;Blank graphics
7E93 F5       02460 SET40   PUSH   AF            ;Save character
7E94 3AB37E   02470         LD     A,(ESTOR)     ;Get draw flag
7E97 FE00     02480         CP     0             ;Check for erase
7E99 200A     02490         JR     NZ,SET50      ;Jump if not erase
7E9B DD7E00   02500         LD     A,(IX+0)      ;Get mask pattern
7E9E 2F       02510         CPL                  ;Complement for erase
7E9F CBFF     02520         SET    7,A           ;Make graphics
7EA1 C1       02530         POP    BC            ;Restore character
7EA2 A0       02540         AND    B             ;Combine with mask
7EA3 77       02550         LD     (HL),A        ;Save in video memory
7EA4 C9       02560         RET                  ;Return to PLOT
7EA5 F1       02570 SET50   POP    AF            ;Restore character
```

Program continued

```
7EA6 DDB600    02580          OR      (IX+0)        ;Set bit
7EA9 77        02590          LD      (HL),A        ;Save in video mem.
7EAA C9        02600          RET                   ;Return to PLOT
7EAB 81        02610 MASK     DEFB    81H           ;Mask table for set
7EAC 82        02620          DEFB    82H
7EAD 84        02630          DEFB    84H
7EAE 88        02640          DEFB    88H
7EAF 90        02650          DEFB    90H
7EB0 A0        02660          DEFB    0A0H
0002           02670 STORE    DEFS    2             ;#1-final count #2-flags
0001           02680 ESTOR    DEFS    1             ;Draw-1 Erase-0 flag
0004           02690 TABLE    DEFS    4             ;Table of coordinates
0000           02700          END
00000 TOTAL ERRORS
```

Program Listing 2

```
10 '
20 '                    *** LISTING 2 ***
30 '
40 ' * LIGHTNING
50 '
60 ' MEM SIZE 32000
70 'FOR DISK - DEFUSR=32000
80 DI=32436
90 X1=RND(127):X2=RND(127):Y1=RND(47):Y2=RND(47)
100 POKEDI,X1:POKEDI+1,Y1:POKEDI+2,X2:POKEDI+3,Y2:CLS:M=USR(0)
110 GOTO 90
```

Program Listing 3

```
5 '
10 '                    *** LISTING 3 ***
15 '
20 ' * RADAR SIMULATOR *
25 '
30 ' MEM SIZE 32000
35 'FOR DISK - DEFUSR=32000
40 C=3.141593/180:DI=32436:POKEDI+2,64:POKEDI+3,24
45 FOR A=0TO 359 STEP 10
50 X1=COS(A*C)*63+64
55 Y1=SIN(A*C)*23+24:M=USR(1)
60 POKEDI,X1:POKEDI+1,Y1:M=USR(0):NEXT:GOTO45
```

13

Defeating the ROM: Scroll Protection

by Daniel J. Scales

System Requirements:
Model I
Level II BASIC
16K

Have you ever wanted to protect text or graphics on the screen so it wouldn't be scrolled off? This capability can be used to keep the headings of a table from disappearing off the top of the screen, or to build up a graphics image step-by-step in command mode without having it move up and off the screen. When I have a lot of disk copying or erasing to do, I find it convenient to protect the top part of the screen and display a directory which remains there until I clear the screen or change the scroll protection.

The Program

The machine-language program in Program Listing 1 controls the scrolling of the screen. It is directly linked to the video output routine in ROM (read-only memory) that is used by Level II BASIC, Disk BASIC, and DOS. The scroll protection works in BASIC, DOS, and almost all machine-language utilities, as long as the memory for the routine is protected. Because it is linked to the ROM's video driver routine, the program is executed every time there is output to the screen, and is completely invisible to the user—no special command is needed every time there is a scroll.

The first part of the routine (see Program Listing 1), named PROT, intercepts the screen driver by placing its own starting address in the screen control block, which usually contains the address of the video output routine, and jumping to the video driver only after the scroll processing is completed. The other part of the machine-language program is

called directly by the user to change the parameters of the scroll routine so that it protects a new specified text area, which may be any set of consecutive lines on the screen.

This SETUP routine is normally called from BASIC by a USR call. Its argument has the form 256*FIRST + LAST, where FIRST is the line number of the start of the text area that is to be scrolled, and LAST is the line number of the end of the text area. When the cursor is in the text area, only the text area is scrolled; the rest of the screen is protected. The cursor can still be placed anywhere on the screen by using a PRINT@ statement or by clearing the screen, and normal scrolling takes place if the cursor is not in the text area.

The scroll protection routine protects the top four lines of the screen (making the text area the last twelve lines of the screen) until SETUP is called to redefine the text area. The lines on the screen are numbered 0–15. If either the FIRST or LAST argument is not between 0 and 15, the argument is divided by 16, and the remainder is used as the line number. The SETUP routine does not check to see if FIRST is less than LAST. It is not possible for FIRST to equal LAST.

How It Works

Normally, the screen must be scrolled only if the cursor is at the last position of the screen and a character is to be printed, or if the cursor is anywhere on the last line of the screen and a line feed is to be printed. The machine-language routine, PROT, in Program Listing 1, does nothing unless the cursor is at the last position of the text area defined by SETUP or on the last line of the text area with a line feed to be printed. If one of these two conditions is true, it executes a special scroll routine that scrolls only the text area without spilling over into the protected regions of the screen. In this way, the scroll routine of the video print subroutine is defeated and is never invoked while the cursor is in the text area.

PROT starts by saving the contents of registers on the stack and loads the HL register with memory location 4020H. The screen image is stored in memory at locations 3C00H to 3FFFH, and 4020H contains the memory address associated with the cursor's location. The routine checks to see if the cursor is on the last character or last line of the text area and whether the character to be printed (which is in the C register on entry to PROT) is a carriage return/line feed (ASCII coded 0D hexadecimal). If both these conditions are true, the routine scrolls only the text area. The scrolling process uses the Z80 LDIR (load, increment, and repeat) instruction to move all the lines of the text area (except the first) up one line, then fills in the last line with blanks, and adjusts the cursor pointer in 4020H. The routine terminates by popping off the stack all the registers that were saved at the beginning of the routine and jumping to the video print routine.

SETUP is the routine which changes various instructions of the PROT routine so that it scrolls the right screen area according to the USR argument. It puts the USR argument in the HL register by calling a BASIC ROM routine, CVINT, at 0A7FH, as described in the Level II manual. It has a subroutine, M64, which takes a line number from 0 to 15 in the A register and returns the memory location asssociated with the first character of that line on the screen. It returns to BASIC after it has made all the necessary changes.

Using the Routine

The scroll protect routine is created using an editor/assembler and loaded in by the Level II SYSTEM command or the DOS LOAD command. The BASIC program in Program Listing 2 can be used to POKE the routine into memory. The POKE values are for a 32K machine. If the program is to POKE into the high memory of a 48K machine, all 191s in the DATA statements and in line 150 should be changed to 255s, and line 140 should start with FOR I= -256 TO -256+141. The routine as shown sets the bottom twelve lines of the screen as the text area and protects the top four lines. You can change the location of the text area by calling the SETUP routine with a USR call, so the address of SETUP must be known. This address is -16570 if the addresses of the BASIC program or assembly listing are not changed. If the 48K modification given above is used, then this address is -186. The lines of the screen are numbered 0-15, and the argument passed to SETUP must be 256*FIRST + LAST, where FIRST and LAST are the line numbers of the first and last lines of the text area. FIRST and LAST should be between 0 and 15, with FIRST less than LAST.

Only the text area scrolls as long as the cursor is in the text area, but if the cursor is not in the text area and is at the bottom of the screen, a normal unprotected scroll takes place. The CLEAR key is not disabled, so you can erase anything in the protected part of the screen at any time by clearing the screen. PROT can be modified to check whether the C register contains 1FH (the ASCII for clear screen), and if so, return to the caller without jumping to the video print routine, thus disabling the CLEAR key. The routine could be changed so that the clear code clears only the current text area.

Program Listing 1. *Scroll protection program*

```
                00100 ;         SCROLL PROTECTION PROGRAM
                00110 ;         MODEL I
                00120 ;         DAN SCALES, 1981
                00130 ;
4020            00140 CURLOC    EQU     4020H
0A7F            00150 CVINT     EQU     0A7FH    ;ROUTINE TO GET INTEGER ARGUMENT
```

Program continued

```
                                                ;OF USR CALL
3CØØ                VIDMEM  EQU     3CØØH       ;LOCATION OF VIDEO MEMORY
Ø458                VIDPR   EQU     458H        ;ROM ROUTINE TO PRINT CHARACTER
                                                ;ON SCREEN
                                                ;
401E                        ORG     401EH       ;LOCATION OF VIDEO DRIVER ADDRESS
401E ØØBF                   DEFW    ØBFØØH      ;CHANGE DRIVER ADDRESS TO ADDRESS
                                                ;OF SCROLL ROUTINE
BFØØ                        ORG     ØBFØØH
BFØØ C5             PROT    PUSH    BC          ;C REGISTER CONTAINS CHARACTER
                                                ;TO BE PRINTED
BFØ1 D5                     PUSH    DE          ;DE CONTAINS ADDRESS OF VIDEO
                                                ;DEVICE CONTROL BLOCK
BFØ2 F5                     PUSH    AF          ;SAVE STATUS FLAGS
BFØ3 2A2Ø4Ø                 LD      HL,(CURLOC)
BFØ6 7C                     LD      A,H
BFØ7 FE3F           ENDTXT  CP      3FH         ;CHECK IF NEAR END OF TEXT AREA
BFØ9 2Ø35                   JR      NZ,POPALL       ;NO NEED TO SCROLL
BFØB 7D                     LD      A,L         ;CHECK IF CURSOR IS AT LAST
BFØC FEFF           LSTCHR  CP      ØFFH        ;POSITION OF TEXT AREA.
BFØE 28ØC                   JR      Z,SCROLL ;IF SO, SCROLL.
BF1Ø 79                     LD      A,C
BF11 FEØD                   CP      ØDH         ;IS LINEFEED TO BE PRINTED?
BF13 2Ø2B                   JR      NZ,POPALL ;NO, DON'T SCROLL
BF15 7D                     LD      A,L
BF16 E6CØ                   AND     ØCØH
BF18 FECØ           LSTLIN  CP      ØCØH
BF1A 2Ø24                   JR      NZ,POPALL ;NOT ON LAST LINE, SO NO SCROLL
BF1C 214Ø3D         SCROLL  LD      HL,3D4ØH
BF1F 11ØØ3D                 LD      DE,3DØØH
BF22 Ø1CØØ2                 LD      BC,2CØH
BF25 EDBØ                   LDIR                ;SCROLL THE SCREEN
BF27 162Ø                   LD      D,2ØH
BF29 21CØ3F         LSTLN2  LD      HL,3FCØH
BF2C Ø14ØØØ                 LD      BC,4ØH
BF2F 72             FILL    LD      (HL),D      ;FILL IN LAST LINE OF TEXT AREA
BF3Ø 23                     INC     HL          ;WITH BLANKS
BF31 ØB                     DEC     BC
BF32 78                     LD      A,B
BF33 B1                     OR      C
BF34 2ØF9                   JR      NZ,FILL
BF36 2A2Ø4Ø                 LD      HL,(CURLOC) ;SUBTRACT 4ØH FROM CURSOR
BF39 11CØFF                 LD      DE,ØFFCØH  ;LOCATION TO ADJUST FOR SCROLL
BF3C 19                     ADD     HL,DE
BF3D 222Ø4Ø                 LD      (CURLOC),HL
BF4Ø F1             POPALL  POP     AF
BF41 D1                     POP     DE
BF42 C1                     POP     BC
BF43 C358Ø4                 JP      VIDPR       ;CONTINUE VIDEO PRINT ROUTINE
BF46 CD7FØA         SETUP   CALL    CVINT       ;GET USR ARGUMENT
BF49 4D                     LD      C,L
BF4A 7C                     LD      A,H         ;GET ADDRESS OF FIRST POSITION
BF4B E61F                   AND     1FH         ;MAKE REGISTER A BETWEEN Ø AND 15
BF4D CD7BBF                 CALL    M64         ;OF FIRST LINE OF TEXT AREA
BF5Ø 222ØBF                 LD      (SCROLL+4),HL
BF53 E5                     PUSH    HL          ;SAVE TOP OF SCROLL AREA FOR LATER
BF54 114ØØØ                 LD      DE,4ØH      ;TO MOVE TEXT UP ONE LINE (4ØH
BF57 19                     ADD     HL,DE       ;CHARACTERS
BF58 221DBF                 LD      (SCROLL+1),HL
BF5B 79                     LD      A,C
BF5C E61F                   AND     1FH         ;MAKE A REGISTER BETWEEN Ø AND 15
```

```
BF5E 3C         00765          INC    A
BF5F CD7BBF     00770          CALL   M64      ;GET ADDRESS OF LAST POSITION
BF62 2B         00780          DEC    HL       ;OF LAST LINE OF TEXT AREA
BF63 7C         00790          LD     A,H
BF64 3208BF     00800          LD     (ENDTXT+1),A
BF67 7D         00810          LD     A,L
BF68 320DBF     00820          LD     (LSTCHR+1),A
BF6B E6C0       00830          AND    0C0H
BF6D 3219BF     00840          LD     (LSTLIN+1),A
BF70 6F         00850          LD     L,A
BF71 222ABF     00860          LD     (LSTLN2+1),HL
BF74 D1         00870          POP    DE       ;RESTORE ADDR OF TOP OF SCROLL AREA
BF75 ED52       00880          SBC    HL,DE    ;HL EQUALS THE NUMBER OF CHARACTERS
BF77 2223BF     00890          LD     (SCROLL+7),HL    ;TO BE SCROLLED
BF7A C9         00900          RET
                00910          ;
                00920          ;M64 IS A ROUTINE TO GET THE ADDRESS OF THE
                00930          ;FIRST POSITION OF THE LINE ON THE SCREEN WHOSE
                00940          ;NUMBER IS IN THE A REGISTER.
BF7B 47         00950 M64      LD     B,A
BF7C 210000     00960          LD     HL,0H
BF7F 114000     00970          LD     DE,40H
BF82 B7         00980          OR     A
BF83 2803       00990          JR     Z,CONT
BF85 19         01000 LOOP     ADD    HL,DE
BF86 10FD       01010          DJNZ   LOOP
BF88 11003C     01020 CONT     LD     DE,VIDMEM ;HL NOW EQUALS 64 TIMES REGISTER A
BF8B 19         01030          ADD    HL,DE
BF8C C9         01040          RET
BF00            01050          END    PROT
00000 TOTAL ERRORS
```

Program Listing 2. *BASIC program*

```
100 ' MODEL I SCROLL PROTECT
110 ' DAN SCALES, 1981
120 '    THE USR ADDRESS TO CHANGE SCROLL PROTECTION IS -16570.
125 ' FOR INSTANCE, TO CHANGE THE TEXT AREA TO ONLY THE BOTTOM
126 ' FOUR LINES, DEFINE THE USR ADDRESS AS -16570, AND THEN
127 ' EXECUTE "X = USR(12 * 256 + 15)".
130 '
140 FOR I=-16640 TO -16640+141:READ X:POKE I,X:NEXT
150 POKE 16414,0:POKE 16415,191    'CHANGE SCREEN DRIVER ADDRESS
200 DATA 197,213,245,42,32,64,124,254,63,32
210 DATA 53,125,254,255,40,12,121,254,13,32
220 DATA 43,125,230,192,254,192,32,36,33,64
230 DATA 61,17,0,61,1,192,2,237,176,22
240 DATA 32,33,192,63,1,64,0,114,35,11
250 DATA 120,177,32,249,42,32,64,17,192,255
260 DATA 25,34,32,64,241,209,193,195,88,4
270 DATA 205,127,10,77,124,230,31,205,123,191
280 DATA 34,32,191,229,17,64,0,25,34,29
290 DATA 191,121,230,31,60,205,123,191,43,124
300 DATA 50,8,191,125,50,13,191,230,192,50
310 DATA 25,191,111,34,42,191,209,237,82,34
320 DATA 35,191,201,71,33,0,0,17,64,0
330 DATA 183,40,3,25,16,253,17,0,60,25
340 DATA 201,0
```

14

Easier Formatting with SCREEN

by Don Robertson

System Requirements:
Model I or III
16K or 32K
Level II or Disk BASIC

The SCREEN program is for the BASIC programmer who wants professional-looking programs but gets frustrated with the time and energy required to format a screen using graphics and alphanumerics. The traditional way to lay out a screen is to PRINT AT, POKE, or PRINT USING. Traditionally, to use the graphics characters, you must look up their ASCII codes and laboriously POKE or use CHR$ to format them. SCREEN lets you move the cursor with complete freedom, using graphics to draw pictures, or putting alphanumeric characters where you want them. When the screen is set up exactly as you want it, the picture is POKEd into the program itself.

The program is easy to run (see Program Listing). First, the current screen appears. To create a new screen, type C. This clears the screen and displays the graphics cursor in the center. To modify the existing screen, type any character except C. Do not press ENTER after your choice, as this tells the program to save whatever is currently displayed on the screen.

The graphics cursor is controlled by the arrow keys. To draw, press the appropriate key. Press two keys simultaneously for diagonal lines. To erase or to move the cursor without drawing, hold down the SHIFT key and press the desired arrow. When SHIFT is pressed, the graphics cursor blinks. This is useful when the screen is almost full and you've forgotten where you are.

SCREEN lets you switch between the graphics and the alphanumeric modes, using the CLEAR key as the switch. When in the alpha mode, the

blinking cursor shows the current position to be typed. Cursor position is controlled by the arrow keys. When the cursor is in the desired position, anything you type appears on the screen, much as it would on a word processor. Use the space bar to erase in the alpha mode.

When you're satisfied with the screen, press ENTER. The program scans the display and POKEs it into program lines 30000-30080. It takes about 20 seconds to dump the screen. When the READY prompt appears, delete lines 31010-33120 and write your BASIC program. Your screen is stored in A1$-A8$ and printed whenever line 31000 is accessed. You *must* type lines 30000-30070 exactly as they appear in the listing. Each of the strings A1$-A8$ must be precisely 128 characters long; these variables are where your new screen is stored.

Lines 31010-31030 find the beginning of A1$, check whether it is a modification or an entirely new screen, and position the graphics cursor in the middle of the display. The program starts in the graphics mode. Lines 31040-31110 check for cursor movement (arrows), alpha switch (CLEAR), and save screen (ENTER). Cursor movement in both modes is smooth and fast, because the program does not use INKEY$ to detect it. Keyboard memory is located in locations 3801H-3880H, with all control characters at 3840H. By PEEKing at 14400 (3840H) and testing for the different controls, the program can handle fast typing and support repeats—even on the Model I.

Alpha characters are handled in essentially the same way as graphics. Lines 33000-33090 detect controls, set the POKEing position, and display any characters you type. The cursor in the alpha mode is non-destructive; the character under the cursor is stored in CH. The ASCII code of any character typed is saved into KB and then POKEd to the screen. Lines 31120-31200 save the screen into variables A1$-A8$ when ENTER is pressed.

Program Listing

```
1 CLEAR1000
30000 A1$="SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCRE
EN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREE
N SCREEN SC"
30010 A2$="REEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN
 SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN
SCREEN SCRE"
30020 A3$="EN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN S
CREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SC
REEN SCREEN"
30030 A4$=" SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCR
EEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCRE
EN SCREEN S"
30040 A5$="CREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREE
N SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN
 SCREEN SCR"
```

Program continued

```
30050 A6$="EEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN
SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN S
CREEN SCREE"
30060 A7$="N SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SC
REEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCR
EEN SCREEN "
30070 A8$="SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCRE
EN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN SCREEN BY DO
N ROBERTSON"
31000 CLS:PRINTA1$;A2$;A3$;A4$;A5$;A6$;A7$;LEFT$(A8$,127);:POKE1
6383,ASC(RIGHT$(A8$,1))
31010 P=VARPTR(A1$)
'
   FIND LOCATION OF A1$
31020 A=PEEK(P+2)*256+PEEK(P+1)
31025 K$=INKEY$:IFK$=""THEN31025ELSEIFK$="C"THENCLS'    C --> CL
EARS SCREEN --> DO ENTIRELY NEW SCREEN  <<-->> ANY OTHER LETTER
LEAVES SCREEN FOR MODIFICATION ONLY
31030 X=63:Y=23:PO=15360'    INITIAL POSITIONS OF CURSORS
31040 M=PEEK(14400):FORI=1TO10:NEXT'    CHECK FOR ARROWS, (MOVE
CURSOR), ENTER (PUNCH SCREEN TO A1$-->A8$), CLEAR (SWITCH IN LET
TER POKER)
31050 IFM=1THEN31120'    ENTER KEYED --> SAVE SCREEN
31055 IFM=2THENFORI=1TO40:NEXTI:GOTO32000'    CLEAR KEYED --> SW
ITCH TO ALPHABETICS
31060 IFMAND8ANDY>0THENY=Y-1'    ARROW KEYED --> MOVE CURSOR
31070 IFMAND16ANDY<47THENY=Y+1
31080 IFMAND32ANDX>0THENX=X-1
31090 IFMAND64ANDX<126THENX=X+1
31100 SET(X,Y):IFPEEK(14464)THENRESET(X,Y)'    SHIFT IS ERASE
31110 GOTO31040
31120 '
 SAVE SCREEN INTO PROGRAM
31140 FOR II=15360TO16320STEP128
31150  FORJJ=0TO127
31160          POKEA+XX*139+JJ,PEEK(II+JJ)
31170  NEXTJJ
31180 XX=XX+1
31190 NEXTII
31200 END
32000 ' ALPHA NUMERIC CHARACTERS POKED HERE
32010 M=PEEK(14400)'    LOOK FOR CONTROL CHARACTER
32015 CH=PEEK(PO):POKEPO,254:P1=PO:POKEP1,CH'    FLASHING CURSOR
32020 IFM>2THEN33000'    NOT CLEAR, NOT ENTER --> CURSOR MOVE
32030 IFM=2THENFORI=1TO40:NEXTI:GOTO31040'    CLEAR  --> SWITCH
TO GRAPHICS
32040 IFM=1THEN31120'    ENTER  --> SAVE INTO PROGRAM
32050 K$=INKEY$:IFK$<>""ANDK$<>"["THENKB=ASC(K$):K$=""'    CHECK
 FOR LETTER
32060 IFKB>31THENPOKEPO,KB:IFPO<16383THENPO=PO+1'    CHECK FOR N
ON-CONTROL CHARACTER IN BUFFER, STORE ON SCREEN, MOVE CURSOR 1 P
OSITION RIGHT
32070 KB=0'    RESET BUFFER
32080 GOTO32010'    GET NEXT CHARACTER
33000 'GET POKING POSITION
33040 IFMAND8ANDPO>15424THENPO=PO-64'    CHECK FOR ARROW  --> MO
VE CURSOR
33050 IFMAND16ANDPO<16320THENPO=PO+64
33060 IFMAND32ANDPO>15360THENPO=PO-1
33070 IFMAND64ANDPO<16383THENPO=PO+1
33090 GOTO32010
```

15

DRAFTER: A Graphics Editor

by R.K. Fink

System Requirements:
Model I or III
32K or 48K
One disk drive

After years of searching for the ideal screen writer, I designed DRAFTER to be both easy to use, and foolproof. It operates quickly, uses few commands, and requires no computations to find TRS-80 block graphic codes. It automatically saves the screen as BASIC lines of data statements, in a file you can merge with another BASIC program. It uses machine-language block moves to speed up operation of screen saves and recalls. Two versions of DRAFTER are provided here—one for 32K systems, and one for 48K systems. Both require one disk drive.

DRAFTER (see Program Listing 1) was developed for a 48K disk system. Program Listing 2 is for a 32K system. The machine-language USR subroutines, which are used to clear buffers, save or recall a screen, or construct a data buffer, are POKEd into high memory from strings. They become invisible when a new data file is merged and POKEd to the screen. The memory maps in Figure 2 show where space is needed for storage buffers and for the operation codes. When you rerun the program, it loads its routines in memory, sets buffers to zero, and starts into the D (draw) mode with the (*) cursor ready for screen construction.

Using DRAFTER

The commands and construction loops are shown in Figure 1. While you are in the draw mode, hitting the SHIFT key saves the screen and displays the main menu. If the data on the screen is to be saved as a group of BASIC DATA statement lines, press S. To append and load a disk file of data previously made, press L. After loading the storage buff-

er and screen you are returned to the draw mode, ready for further construction. X exits to BASIC, but gives you a second chance with a prompt if your data has not been saved to disk.

While in the draw mode, ASCII keyboard characters may be entered at the cursor by pressing CLEAR while typing the desired character. Regular graphic blocks are built by pressing the keys shown on the numeric keypad. If you don't have a numeric keypad, use the numbers along the top key row—with a loss, however, of the relative position, or touch feel, of building a rectangular block. When a block is begun you are in a loop that can be erased and restarted with the space bar. When you're satisfied, press the ENTER key to enter the graphics equivalent. The cursor reappears.

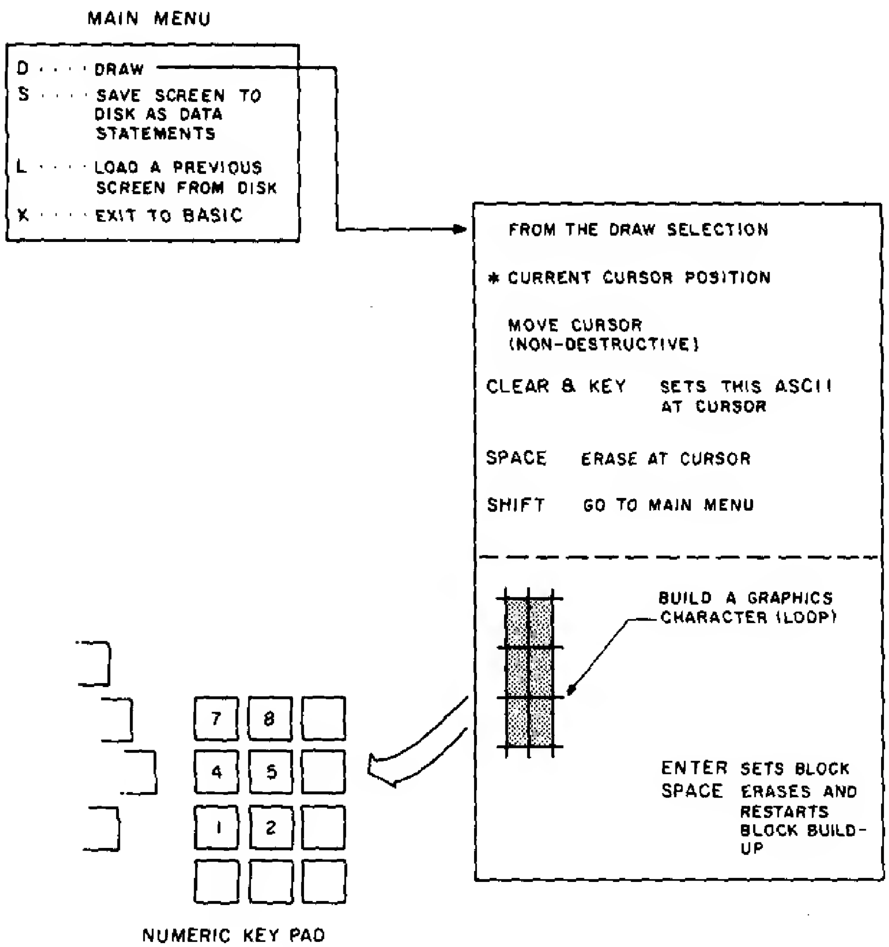


Figure 1. *Commands*

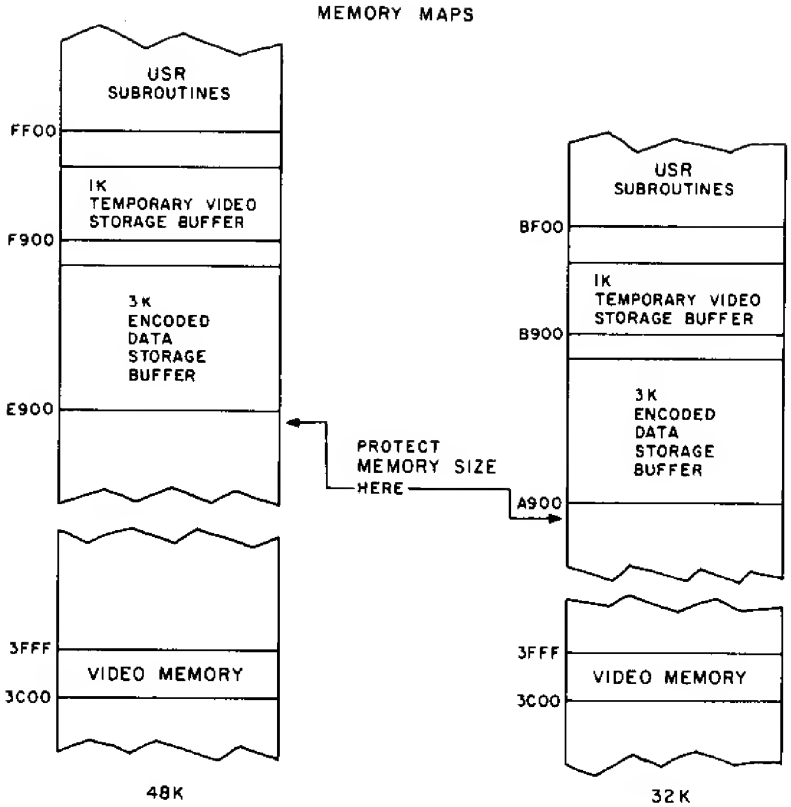


Figure 2. *Memory Maps*

The cursor has automatic repeat movement. The non-destructive cursor stops at any boundary position. To erase a position, hit the space bar, and the character at the cursor is erased. You can make a data file of your screen with the S command, then use MERGE"filespec" to append it to any other program. These lines always start at 20000, so put nothing above this in your other program. Only active screen locations with character contents other than a space are saved. It's assumed that the screen is cleared with a CLS command before POKEing the data in later programs. To use the created DATA statements note that there are three numbers per location: MSB, LSB of screen address (not in reversed order like Z80 operation code), and the screen character's ASCII code.

A simple program loop to fill the screen follows:

```
CLS
FOR N=1 TO (Length of the active data locations)
READ M,L,D : AD=M*16+L
POKE AD,D
NEXT N
```

Figure continued

NAME	DESCRIPTION
A$ AA$	Temporary Data Input
AD	POKE Address
CC	Cursor Character
DA	Current Character Buildup
F$	Filespec for Disk
I N	Closed Loop Counters
KD	Keyboard Input of NUMBERS Row
KB	Keyboard Input of ARROWS Row
LN$	ASCII DATA Statements Created
PS	Current Cursor Position
PO	Temporary POKE Address
S	Start of Screen
SA	Start Address of Op Codes
SL	Line No. of BASIC DATA Lines
U0$-U3$	Strings for USR Subroutine Codes

SUBROUTINES USED

LINE #	DESCRIPTION
1500	USR Subroutines
2000	Save DATA Statements To Disk
3500	Load Data From Disk

Figure 3. *Major symbols and subroutines*

DRAFTER also lets you construct and save a loadable file of a sketch in just a few minutes. To start, cover a video worksheet with celluloid and use a grease pencil to get rough starting proportions. To demonstrate the technique, I constructed a Giant Android in about eight minutes and saved it as Program Listing 3. DRAFTER put all those data lines automatically on disk. If you want a starting point, put the data lines into an ASCII file from the keyboard and then load them into DRAFTER.

Program Listing 1

```
1 ' ****  DRAFTING BOARD AND DATA ENCODER  ****
2 '   **   DRAFTER/BAS  MOD I DISK 32 OR 48K **
3 '   **    RK FINK  1/20/82   VER 1.0      **
4 '   **     FOR THIS 48K VERSION ....      **
5 '   **      PROTECT 50000 TO ENTER BASIC  **
6 '   ** :::::::::::::::::::::::::::::::::: **
7 '
8 '
9 CLS:PRINTCHR$(23);"L O W
   R E S
     G R A P H I C S
       T A B L E T":FORN=1TO3000:NEXT
10 CLEAR500:CLS
15 DEFINTA-Z:GOSUB1500:GOSUB1700
```

```
20 ONERRORGOTO0:S=15360
30 X=0:Y=0:CC=42:DA=128
40 PS=S+X+64*Y:TP=PEEK(PS)
49 '   ::::: The Main program Loop :::::
50 POKEPS,CC:GOSUB200:GOSUB270
60 IFPEEK(14464)=0THEN50
68 '   :::::          :::          :::::
69 '   :::::  The Main Menu Routine    ::::
70 GOSUB1000
80 CLS:PRINT
90 PRINTTAB(8)"  DRAFTING BOARD AND DATA STATEMENT ENCODER"
100 PRINT:PRINTTAB(25)"M E N U"
110 PRINT"         D .... START OR CONTINUE DRAWING
         S .... SAVE A SCREEN & PUT DATA ON DISK
         L .... LOAD A PREVIOUS SCREEN FROM DISK
         X .... EXIT TO BASIC"
120 PRINT:PRINT"SELECTION......??"
130 AA$=INKEY$:IFAA$=""THEN130
140 IFAA$="X"THENCLS:PRINT"SURE DATA'S SAVED??    REALLY EXIT (Y
/N)":INPUTAA$:IFAA$="N"THEN90ELSEEND
150 IFAA$="S"THEN2000
160 IFAA$="D"THENCLS:Z=USR2(0):GOTO30
170 IFAA$="L"THENCLS:GOTO3500
180 GOTO130
200 KB=PEEK(14400):IFKB=0THENRETURN
201 IFKB<>2THEN210
202 IFPEEK(14400)=2THEN202
203 POKEPS,128:DA$=INKEY$:IFDA$=""THEN203
204 DA=ASC(DA$):POKEPS,DA:TP=DA:FORN=1TO200:NEXT:RETURN
210 IF(KB=32)AND(X<>0)THENX=X-1:POKEPS,TP:PS=S+X+64*Y:TP=PEEK(PS
):POKEPS,CC:RETURN
220 IF(KB=64)AND(X<>63)THENX=X+1:POKEPS,TP:PS=S+X+64*Y:TP=PEEK(P
S):POKEPS,CC:RETURN
230 IF(KB=8)AND(Y>0)THENY=Y-1:POKEPS,TP:PS=S+X+64*Y:TP=PEEK(PS):
POKEPS,CC:RETURN
240 IF(KB=16)AND(Y<15)THENY=Y+1:POKEPS,TP:PS=S+X+64*Y:TP=PEEK(PS
):POKEPS,CC:RETURN
250 IF(KB=128)THENPOKEPS,128:FORN=1TO200:NEXT:TP=128:RETURN
260 ' .... Construct A Graphics Block Loop Follows ....
270 KD=PEEK(14352):IFKD=0THENRETURN
280 IFPEEK(14400)=128THENPOKEPS,128:DA=128
290 IFPEEK(14400)=1THENPOKEPS,DA:TP=DA:DA=128:RETURN
300 IFKD=128THENDA=DAOR1ELSEIFPEEK(14368)=1THENDA=DAOR2
310 IFKD=16THENDA=DAOR4ELSEIFKD=32THENDA=DAOR8
320 IFKD=2THENDA=DAOR16ELSEIFKD=4THENDA=DAOR32
330 POKEPS,DA:KD=PEEK(14352):TP=DA:GOTO280
1000 POKEPS,TP
1010 Z=USR1(0):RETURN
1498 ' ... These are the string packers that set up
1499 '       the USR subroutines ....
1500 PRINT"INITIALIZING PROGRAM ROUTINES ........."
1505 U0$="1101E92100E9AF77010014EDB0C9"
1510 PO=&HFF00:FORI=1TOLEN(U0$)STEP2:L=ASC(MID$(U0$,I))-48
1520 R=ASC(MID$(U0$,I+1))-48:L=L+7*(L>9):R=R+7*(R>9)
1530 POKEPO,16*L+R:PO=PO+1:NEXTI
1540 DEFUSR0=&HFF00
1541 '   USR0 ... Clears buffers with zeros
1550 U1$="1100F921003C010004EDB0C9"
1560 PO=&HFF10:FORI=1TOLEN(U1$)STEP2:L=ASC(MID$(U1$,I))-48
1570 R=ASC(MID$(U1$,I+1))-48:L=L+7*(L>9):R=R+7*(R>9)
1580 POKEPO,16*L+R:PO=PO+1:NEXTI
```

Program continued

```
1590 DEFUSR1=&HFF10
1591 '  USR1 ... Saves screen to video buffer ...
1600 U2$="11003C2100F9010004EDB0C9"
1610 PO=&HFF20:FORI=1TOLEN(U2$)STEP2:L=ASC(MID$(U2$,I))-48
1620 R=ASC(MID$(U2$,I+1))-48:L=L+7*(L>9):R=R+7*(R>9)
1630 POKEPO,16*L+R:PO=PO+1:NEXTI
1640 DEFUSR2=&HFF20
1641 '  USR2 ... Moves saved buffer back to screen ...
1650 U3$="0100FD11003C2100F9DD2100E9FD210007EFE802819FE202815DD
7200DD23DD7300DD23DD7700DD23FD23FD23FD232313E5ED427CB52803E118D6
E1FDE5E1C39A0A"
1660 PO=&HFF30:FORI=1TOLEN(U3$)STEP2:L=ASC(MID$(U3$,I))-48
1670 R=ASC(MID$(U3$,I+1))-48:L=L+7*(L>9):R=R+7*(R>9)
1680 POKEPO,16*L+R:PO=PO+1:NEXTI
1690 DEFUSR3=&HFF30:RETURN
1691 '  USR3 ... Construct Data Buffer from video buffer
1700 Z=USR0(0):CLS:RETURN:   'Clear Buffers TO ZEROS ...
1999 ' ... Construct Data Statements & Save To Disk ...
2000 CLS
2010 PRINT
2020 LE=USR3(0):IFPEEK(&HE900)=0THENPRINT"NO VIDEO TEXT IN BUFFE
R":FORN=1TO500:NEXT:CLS:GOTO30
2030 PRINT:LINE INPUT"FILESPEC FOR DATA SAVE? ";F$:OPEN"O",1,F$
2040 PRINT:PRINT"SAVING DATA LINES ....."
2050 SA=&HE900:SL=20000:GOSUB4000
2060 LN$=LN$+"DATA"
2070 FORN=SATOSA+LE-1
2075 IFLEN(LN$)<60THEN2110
2080 LN$=LEFT$(LN$,LEN(LN$)-1)
2090 GOSUB5000:GOSUB4000
2100 LN$=LN$+"DATA"
2110 A$=STR$(PEEK(N)):A$=RIGHT$(A$,LEN(A$)-1)
2120 LN$=LN$+A$+","
2140 NEXTN
2150 LN$=LEFT$(LN$,LEN(LN$)-1)
2160 GOSUB5000
2170 CLOSE
2180 GOTO90
3499 ' ... Load in a Diskfile of Data Statements ...
3500 CLS:LINE INPUT"FILENAME OF DATA? ";F$:PRINT
3510 PRINT"ENTER    RUN 3600 AT THE 'READY' PROMPT"
3520 PRINT:PRINT
3530 MERGEF$:END
3600 PRINT"RESETTING PROGRAM SUBROUTINES .....":GOSUB1505:GOSUB1
700
3610 ONERRORGOTO3650
3620 FORN=1TO3072:READM,L,D
3630 AD=M*256+L:POKEAD,D
3640 NEXT
3649 ' ... When all data is exhausted, jump below on error
3650 Z=USR1(0):RESUME20
4000 LN$=RIGHT$(STR$(SL),LEN(STR$(SL))-1)+" ":RETURN
5000 PRINT#1,LN$ : SL=SL+10 : RETURN
20000 DATA61,71,191,61,151,131,61,152,191,61,153,131,61,157
20010 DATA131,61,158,191,61,159,131,61,216,191,61,217,176,61
20020 DATA218,176,61,219,191,61,220,176,61,221,176,61,222,191
20030 DATA62,25,140,62,26,140,62,27,140,62,28,140,62,29,140
20040 DATA62,30,140,62,88,131,62,135,191
```

Program Listing 2. *Changes to provide a 32K system program*

```
1 ' ****  DRAFTING BOARD AND DATA ENCODER  ****
2 '   **   DRAFTER/BAS  MOD I DISK 32 OR 48K **
3 '   **    RK FINK  1/2Ø/82   VER 1.Ø       **
4 '   **     FOR THIS 32K VERSION ....       **
5 '   **      PROTECT 43ØØØ TO ENTER BASIC   **
6 '   ** :::::::::::::::::::::::::::::::::: **
7 '
8 '
9 CLS:PRINTCHR$(23);"L O W
   R E S
     G R A P H I C S
       T A B L E T":FORN=1TO3ØØØ:NEXT
1Ø CLEAR5ØØ:CLS
15 DEFINTA-Z:GOSUB15ØØ:GOSUB17ØØ
2Ø ONERRORGOTOØ:S=1536Ø
3Ø X=Ø:Y=Ø:CC=42:DA=128
4Ø PS=S+X+64*Y:TP=PEEK(PS)
49 '  ::::: The Main program Loop :::::
5Ø POKEPS,CC:GOSUB2ØØ:GOSUB27Ø
6Ø IFPEEK(14464)=ØTHEN5Ø
68 '  :::::          :::          :::::
69 '  :::::  The Main Menu Routine   ::::
7Ø GOSUB1ØØØ
8Ø CLS:PRINT
9Ø PRINTTAB(8)"  DRAFTING BOARD AND DATA STATEMENT ENCODER"
1ØØ PRINT:PRINTTAB(25)"M E N U"
11Ø PRINT"         D .... START OR CONTINUE DRAWING
         S .... SAVE A SCREEN & PUT DATA ON DISK
         L .... LOAD A PREVIOUS SCREEN FROM DISK
         X .... EXIT TO BASIC"
12Ø PRINT:PRINT"SELECTION......??"
13Ø AA$=INKEY$:IFAA$=""THEN13Ø
14Ø IFAA$="X"THENCLS:PRINT"SURE DATA'S SAVED??   REALLY EXIT (Y
/N)":INPUTAA$:IFAA$="N"THEN9ØELSEEND
15Ø IFAA$="S"THEN2ØØØ
16Ø IFAA$="D"THENCLS:Z=USR2(Ø):GOTO3Ø
17Ø IFAA$="L"THENCLS:GOTO35ØØ
18Ø GOTO13Ø
2ØØ KB=PEEK(144ØØ):IFKB=ØTHENRETURN
2Ø1 IFKB<>2THEN21Ø
2Ø2 IFPEEK(144ØØ)=2THEN2Ø2
2Ø3 POKEPS,128:DA$=INKEY$:IFDA$=""THEN2Ø3
2Ø4 DA=ASC(DA$):POKEPS,DA:TP=DA:FORN=1TO2ØØ:NEXT:RETURN
21Ø IF(KB=32)AND(X<>Ø)THENX=X-1:POKEPS,TP:PS=S+X+64*Y:TP=PEEK(PS
):POKEPS,CC:RETURN
22Ø IF(KB=64)AND(X<>63)THENX=X+1:POKEPS,TP:PS=S+X+64*Y:TP=PEEK(P
S):POKEPS,CC:RETURN
23Ø IF(KB=8)AND(Y>Ø)THENY=Y-1:POKEPS,TP:PS=S+X+64*Y:TP=PEEK(PS):
POKEPS,CC:RETURN
24Ø IF(KB=16)AND(Y<15)THENY=Y+1:POKEPS,TP:PS=S+X+64*Y:TP=PEEK(PS
):POKEPS,CC:RETURN
25Ø IF(KB=128)THENPOKEPS,128:FORN=1TO2ØØ:NEXT:TP=128:RETURN
26Ø ' .... Construct A Graphics Block Loop Follows ....
27Ø KD=PEEK(14352):IFKD=ØTHENRETURN
28Ø IFPEEK(144ØØ)=128THENPOKEPS,128:DA=128
29Ø IFPEEK(144ØØ)=1THENPOKEPS,DA:TP=DA:DA=128:RETURN
3ØØ IFKD=128THENDA=DAOR1ELSEIFPEEK(14368)=1THENDA=DAOR2
31Ø IFKD=16THENDA=DAOR4ELSEIFKD=32THENDA=DAOR8
32Ø IFKD=2THENDA=DAOR16ELSEIFKD=4THENDA=DAOR32
```

Program continued

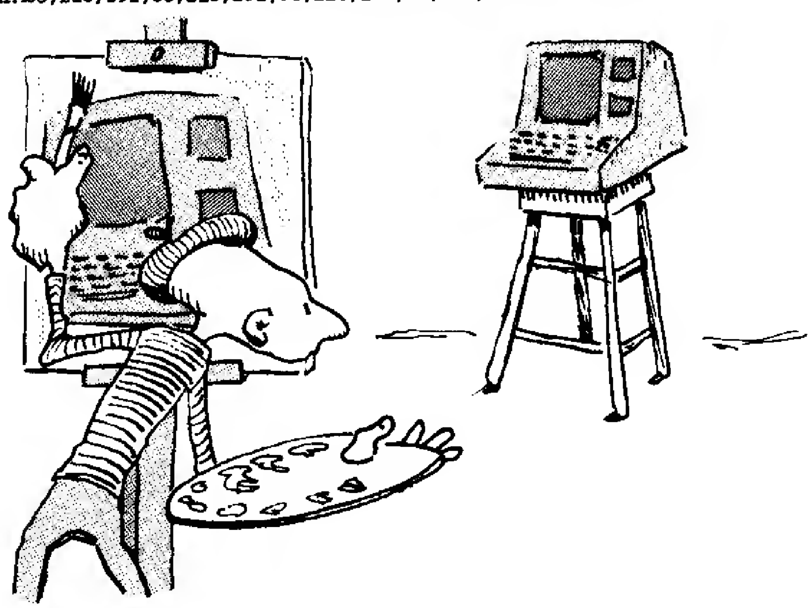
```
330 POKEPS,DA:KD=PEEK(14352):TP=DA:GOTO28Ø
1ØØØ POKEPS,TP
1Ø1Ø Z=USR1(Ø):RETURN
1498 ' ... These are the string packers that set up
1499 '      the USR subroutines ....
15ØØ PRINT"INITIALIZING PROGRAM ROUTINES .........."
15Ø5 UØ$="11Ø1A921ØØA9AF77Ø1ØØ14EDBØC9"
151Ø PO=&HBFØØ:FORI=1TOLEN(UØ$)STEP2:L=ASC(MID$(UØ$,I))-48
152Ø R=ASC(MID$(UØ$,I+1))-48:L=L+7*(L>9):R=R+7*(R>9)
153Ø POKEPO,16*L+R:PO=PO+1:NEXTI
154Ø DEFUSRØ=&HBFØØ
1541 '  USRØ ... Clears buffers with zeros
155Ø U1$="11ØØB921ØØ3CØ1ØØØ4EDBØC9"
156Ø PO=&HBF1Ø:FORI=1TOLEN(U1$)STEP2:L=ASC(MID$(U1$,I))-48
157Ø R=ASC(MID$(U1$,I+1))-48:L=L+7*(L>9):R=R+7*(R>9)
158Ø POKEPO,16*L+R:PO=PO+1:NEXTI
159Ø DEFUSR1=&HBF1Ø
1591 '  USR1 ... Saves screen to video buffer ...
16ØØ U2$="11ØØ3C21ØØB9Ø1ØØØ4EDBØC9"
161Ø PO=&HBF2Ø:FORI=1TOLEN(U2$)STEP2:L=ASC(MID$(U2$,I))-48
162Ø R=ASC(MID$(U2$,I+1))-48:L=L+7*(L>9):R=R+7*(R>9)
163Ø POKEPO,16*L+R:PO=PO+1:NEXTI
164Ø DEFUSR2=&HBF2Ø
1641 '  USR2 ... Moves saved buffer back to screen ...
165Ø U3$="Ø1ØØBD11ØØ3C21ØØB9DD21ØØA9FD21ØØØØ7EFE8Ø2819FE2Ø2815DD
72ØØDD23DD73ØØDD23DD77ØØDD23FD23FD23FD232313E5ED427CB528Ø3E118D6
E1FDE5E1C39AØA"
166Ø PO=&HBF3Ø:FORI=1TOLEN(U3$)STEP2:L=ASC(MID$(U3$,I))-48
167Ø R=ASC(MID$(U3$,I+1))-48:L=L+7*(L>9):R=R+7*(R>9)
168Ø POKEPO,16*L+R:PO=PO+1:NEXTI
169Ø DEFUSR3=&HBF3Ø:RETURN
1691 '  USR3 ... Construct Data Buffer from video buffer
17ØØ Z=USRØ(Ø):CLS:RETURN:    'Clear Buffers TO ZEROS ...
1999 ' ... Construct Data Statements & Save To Disk ...
2ØØØ CLS
2Ø1Ø PRINT
2Ø2Ø LE=USR3(Ø):IFPEEK(&HA9ØØ)=ØTHENPRINT"NO VIDEO TEXT IN BUFFE
R":FORN=1TO5ØØ:NEXT:CLS:GOTO3Ø
2Ø3Ø PRINT:LINEINPUT"FILESPEC FOR DATA SAVE? ";F$:OPEN"O",1,F$
2Ø4Ø PRINT:PRINT"SAVING DATA LINES ....."
2Ø5Ø SA=&HA9ØØ:SL=2ØØØØ:GOSUB4ØØØ
2Ø6Ø LN$=LN$+"DATA"
2Ø7Ø FORN=SATOSA+LE-1
2Ø75 IFLEN(LN$)<6ØTHEN211Ø
2Ø8Ø LN$=LEFT$(LN$,LEN(LN$)-1)
2Ø9Ø GOSUB5ØØØ:GOSUB4ØØØ
21ØØ LN$=LN$+"DATA"
211Ø A$=STR$(PEEK(N)):A$=RIGHT$(A$,LEN(A$)-1)
212Ø LN$=LN$+A$+","
214Ø NEXTN
215Ø LN$=LEFT$(LN$,LEN(LN$)-1)
216Ø GOSUB5ØØØ
217Ø CLOSE
218Ø GOTO9Ø
3499 ' ... Load in a Diskfile of Data Statements ...
35ØØ CLS:LINEINPUT"FILENAME OF DATA? ";F$:PRINT
351Ø PRINT"ENTER    RUN 36ØØ AT THE 'READY' PROMPT"
352Ø PRINT:PRINT
353Ø MERGEF$:END
36ØØ PRINT"RESETTING PROGRAM SUBROUTINES .....":GOSUB15Ø5:GOSUB1
7ØØ
```

```
3610 ONERRORGOTO3650
3620 FORN=1TO3072:READM,L,D
3630 AD=M*256+L:POKEAD,D
3640 NEXT
3649 ' ... When all data is exhausted, jump below on error
3650 Z=USR1(0):RESUME20
4000 LN$=RIGHT$(STR$(SL),LEN(STR$(SL))-1)+" ":RETURN
5000 PRINT#1,LN$:SL=SL+10:RETURN
```

Program Listing 3.

A Giant Android. These BASIC lines were constructed automatically by DRAFTER after about 10 minutes of screen construction time.

```
20000 DATA60,17,71,60,19,73,60,21,65,60,23,78,60,25,84,60,28
20010 DATA65,60,30,78,60,32,68,60,34,82,60,36,79,60,38,73,60
20020 DATA40,68,60,90,188,60,94,188,60,154,191,60,158,191,60
20030 DATA216,191,60,217,191,60,218,191,60,219,191,60,220,191
20040 DATA60,221,191,60,222,191,60,223,191,60,224,191,61,23
20050 DATA170,61,24,191,61,26,170,61,27,191,61,28,191,61,29
20060 DATA191,61,30,149,61,32,191,61,33,149,61,87,170,61,88
20070 DATA191,61,89,149,61,95,170,61,96,191,61,97,149,61,151
20080 DATA130,61,152,131,61,153,131,61,154,143,61,155,143,61
20090 DATA156,143,61,157,143,61,158,143,61,159,131,61,160,131
20100 DATA61,161,129,61,213,160,61,214,176,61,215,176,61,216
20110 DATA176,61,217,176,61,218,150,61,219,131,61,220,131,61
20120 DATA221,131,61,222,131,61,223,180,61,224,176,61,225,176
20130 DATA61,226,176,62,21,191,62,25,191,62,32,191,62,35,191
20140 DATA62,84,190,62,89,191,62,96,191,62,100,189,62,147,186
20150 DATA62,152,170,62,153,191,62,160,191,62,161,149,62,165
20160 DATA181,62,211,142,62,216,170,62,217,191,62,224,191,62
20170 DATA225,149,62,229,141,63,25,191,63,32,191,63;88,191,63
20180 DATA97,191,63,152,191,63,161,191,63,214,188,63,215,188
20190 DATA63,216,191,63,225,191,63,226,188,63,227,188
```



16

HELP with Commands

by Phil Comeau

System Requirements:
Model I or III
16K RAM
One disk drive
Editor/assembler
TRSDOS-compatible DOS

Sometimes a short reminder can be more valuable than a three-page description in a user's manual. TRSDOS's LIB function displays a list of the available commands on the video screen, but many of them require extra parameters, and remembering the formats and possibilities of each command is not an easy task. The HELP program (Program Listing 1) does it for you. Type in the name of the command or feature you're unsure of, and HELP tells you about it. For example, if you type HELP DEBUG, HELP responds:

```
DEBUG (ON/OFF)
  ACTIVATES OR DEACTIVATES DEBUGGING MONITOR
FOR MORE INFORMATION TYPE "HELP DEBUG COMMANDS"
```

HELP can also tell you about the input formats expected by a general ledger program, or Scripsit formatting commands. It can also be used for purposes as diverse as an address and phone number list or a quick recipe reference.

How It Works

HELP begins by getting some information from the command line buffer, the place in memory where DOS stores the last command entered. You type HELP and a word, called the search keyword, describing the information you need. A list of available keywords and their associated informational messages is stored in the HELP program. HELP searches this list until it locates either the keyword or the end of the list. If it finds the keyword, the message following the keyword is displayed

on the video screen. If it reaches end of the list without finding the keyword, HELP displays the message SORRY—NO HELP IS AVAILABLE FOR (the keyword). In either case, HELP then returns to DOS.

The HELP program, as written, provides information on DOS command formats. Both the keywords and the help messages are stored as strings. The last byte of each string is a special character called end-of-string, or EOS. EOS typically has the value zero.

There are two advantages to storing text in this manner. First, strings may have variable length. There is no arbitrary restriction that says the search keyword must be, for example, eight characters long. Second, because it uses a consistent format to store the text, some general purpose subroutines can be used. For instance, the subroutine DSPSTR, which is used to display a string on the video screen, can be lifted out of this program and used in another one. As long as DSPSTR is called correctly (with the HL register pair pointing to a string terminated by EOS), it will function properly.

In this program, the list of keywords and help messages is stored as strings in memory, starting at the symbol HLPLST and ending at the symbol ENDLST. Each entry in the list is formed by a keyword, followed immediately by the help message associated with that keyword.

I used EDTASM to assemble HELP. With this assembler, text can be represented with the DEFM (define message) pseudo instruction (it is called a pseudo instruction because it does not generate machine code). Each string defined with a DEFM consists of text followed by the symbol EOS, which is given the value zero in an EQUate near the start of the program.

Each line of the help message, except the last, ends with a carriage return (CR). This causes printing to resume at the beginning of the next line when the message is displayed. It does not mark the end of the string. Two carriage returns appearing together generate a blank line before printing resumes. Any number of carriage returns may appear within the message string.

If you want to replace or add to the help list with your own entries, Program Listing 2 shows how. If the strings in this program are included in your HELP program, typing HELP MARY SMITH results in this display:

```
MARY SMITH
111 1ST STREET
ATOWN, WHEREVER
PHONE: 123-4567
```

The first keyword in the help list consists only of the EOS code. This is a null string, used when no search keyword is entered in the command line. The null search keyword matches with the null help list keyword. HELP gives you a display of all the available keywords known to HELP.

Program Listing 1

```
                ;       HELP V1.1 25-JUL-82
                ;       AUTHOR: PHIL COMEAU
                ;       DATE WRITTEN: Ø3-DEC-81
                ;
                ;       CONSTANTS
                ;
ØØØ1            BREAK   EQU 1            ;<BREAK>
4318            CML     EQU 4318H        ;DOS COMMAND LINE
ØØØD            CR      EQU ØDH          ;CARRIAGE RETURN
4Ø2D            DOS     EQU 4Ø2DH        ;TRSDOS RE-ENTRY POINT
ØØ33            DSPC    EQU 33H          ;CHARACTER DISPLAY RTN
ØØØØ            EOS     EQU Ø            ;END OF STRING
ØØ2Ø            SPACE   EQU ' '
                ;
                ;       MAINLINE
                ;
52ØØ                    ORG 52ØØH
52ØØ 3EØD       HELP:   LD A,CR          ;LEAVE A BLANK LINE
52Ø2 CD33ØØ             CALL DSPC
52Ø5 11995F             LD DE,KEYWRD     ;GET KEYWORD FROM CMD LINE
52Ø8 CD4852             CALL GETCML
                ;
52ØB 21C252             LD HL,HLPLST
52ØE 11765F     SRCHLP: LD DE,ENDLST     ;SRCH FOR KW UNTIL WE REACH
5211 E5                 PUSH HL          ;THE END OF THE TABLE
5212 B7                 OR A
5213 ED52               SBC HL,DE
5215 E1                 POP HL
5216 F23452             JP P,NOTFND
                ;
5219 11995F             LD DE,KEYWRD     ;HAVE WE FOUND THE KEYWORD?
521C 23                 INC HL
521D CD8C52             CALL CMPSTR
522Ø CA2D52             JP Z,FOUND
                ;
5223 CD7F52             CALL SKPSTR      ;IF NOT, FIND END OF KW
5226 23                 INC HL
5227 CD7F52             CALL SKPSTR      ;THEN SKIP TO NEXT KW
522A C3ØE52             JP SRCHLP
                ;
522D 23         FOUND:  INC HL           ;IF FOUND, DISPLAY THE
522E CDB252             CALL DSPSTR      ;HELP MESSAGE
5231 C34Ø52             JP HLEXIT        ;AND END
                ;
5234 21765F     NOTFND: LD HL,NFMSG      ;IF NOT FOUND, SAY SO
5237 CDB252             CALL DSPSTR
523A 21995F             LD HL,KEYWRD
523D CDB252             CALL DSPSTR
                ;
524Ø 3EØD       HLEXIT: LD A,CR          ;LEAVE A BLANK LINE
5242 CD33ØØ             CALL DSPC
5245 C32D4Ø             JP DOS           ;BACK TO DOS
                ;
                ;
                ;       GETCML: GET PARAM STRING FROM CMD LINE
                ;       ENTRY: DE POINTS TO START OF PARAM STRING BFR
                ;       EXIT:  DE POINTS TO END OF PARAMETER STRING
                ;
```

```
5248 F5         ØØ59Ø GETCML: PUSH AF
5249 E5         ØØ6ØØ         PUSH HL
524A 211843     ØØ61Ø         LD HL,CML             ;POINT TO CMD LINE
                ØØ62Ø ;
524D 7E         ØØ63Ø SKIPNM: LD A,(HL)             ;SKIP PROGRAM NAME
524E FE2Ø       ØØ64Ø         CP SPACE              ;BY FINDING 1ST SPACE
525Ø CA5E52     ØØ65Ø         JP Z,SKIPSP
5253 FEØD       ØØ66Ø         CP CR                 ;OR CR
5255 CA5E52     ØØ67Ø         JP Z,SKIPSP
5258 FEØ1       ØØ68Ø         CP BREAK              ;OR BREAK
525A 23         ØØ69Ø         INC HL                ;IN CMD LINE
525B C34D52     ØØ7ØØ         JP SKIPNM
                ØØ71Ø ;
525E 7E         ØØ72Ø SKIPSP: LD A,(HL)             ;FIND 1ST NON-SPACE CHAR
525F FE2Ø       ØØ73Ø         CP SPACE
5261 C26852     ØØ74Ø         JP NZ,LDPRM
5264 23         ØØ75Ø         INC HL
5265 C35E52     ØØ76Ø         JP SKIPSP
                ØØ77Ø ;
5268 7E         ØØ78Ø LDPRM:  LD A,(HL)             ;LOAD PARAM INTO (DE)
5269 FEØD       ØØ79Ø         CP CR                 ;UNTIL A <CR>
526B CA7952     ØØ8ØØ         JP Z,GCEXIT
526E FEØ1       ØØ81Ø         CP BREAK              ;OR A <BREAK> IS FOUND
527Ø CA7952     ØØ82Ø         JP Z,GCEXIT
5273 12         ØØ83Ø         LD (DE),A
5274 23         ØØ84Ø         INC HL                ;TRY NEXT CHAR
5275 13         ØØ85Ø         INC DE
5276 C36852     ØØ86Ø         JP LDPRM
                ØØ87Ø ;
5279 3EØØ       ØØ88Ø GCEXIT: LD A,EOS          ;MARK THE END OF STRING
527B 12         ØØ89Ø         LD (DE),A
527C E1         ØØ9ØØ         POP HL
527D F1         ØØ91Ø         POP AF
527E C9         ØØ92Ø         RET
                ØØ93Ø ;
                ØØ94Ø ;
                ØØ95Ø ;       SKPSTR: FIND END OF STRING
                ØØ96Ø ;       ENTRY: HL POINTS TO START OF STRING
                ØØ97Ø ;       EXIT:  HL POINTS TO EOS
                ØØ98Ø ;
527F F5         ØØ99Ø SKPSTR: PUSH AF
528Ø 7E         Ø1ØØØ SKPLP:  LD A,(HL)             ;WHILE (HL)<>EOS
5281 FEØØ       Ø1Ø1Ø         CP EOS
5283 CA8A52     Ø1Ø2Ø         JP Z,SKEXIT
5286 23         Ø1Ø3Ø         INC HL                ;TRY NEXT CHAR
5287 C38Ø52     Ø1Ø4Ø         JP SKPLP
528A F1         Ø1Ø5Ø SKEXIT: POP AF
528B C9         Ø1Ø6Ø         RET
                Ø1Ø7Ø ;
                Ø1Ø8Ø ;
                Ø1Ø9Ø ;       CMPSTR: COMPARE STRINGS
                Ø11ØØ ;       ENTRY: HL POINTS TO START OF STRING1
                Ø111Ø ;              DE POINTS TO START OF STRING2
                Ø112Ø ;       EXIT:  HL POINTS TO END OF STRING1 OR
                Ø113Ø ;                   PLACE WHERE (HL)<>(DE)
                Ø114Ø ;              DE POINTS TO END OF STRING2 OR
                Ø115Ø ;                   PLACE WHERE (HL)<>(DE)
                Ø116Ø ;              AF = -1 IF (HL) < (DE)
                Ø117Ø ;                    Ø IF (HL) = (DE)
                Ø118Ø ;                   +1 IF (HL) > (DE)
```

Program continued

```
               01190 ;
528C C5        01200 CMPSTR: PUSH BC
528D 1A        01210 CSLP:   LD A,(DE)          ;WHILE (HL)=(DE)
528E BE        01220         CP (HL)
528F C29D52    01230         JP NZ,NOTEQ
5292 7E        01240         LD A,(HL)          ;AND (HL)<>EOS
5293 FE00      01250         CP EOS
5295 CAAE52    01260         JP Z,EQ
5298 23        01270         INC HL             ;TRY NEXT CHAR
5299 13        01280         INC DE
529A C38D52    01290         JP CSLP
               01300 ;
529D 1A        01310 NOTEQ:  LD A,(DE)          ;IF (HL)<(DE)
529E 47        01320         LD B,A
529F 7E        01330         LD A,(HL)
52A0 90        01340         SUB B
52A1 F2A952    01350         JP P,GT
52A4 3EFF      01360         LD A,0FFH          ;THEN RETURN -1
52A6 C3B052    01370         JP CSEXIT
52A9 3E01      01380 GT:     LD A,1             ;ELSE RETURN +1
52AB C3B052    01390         JP CSEXIT
               01400 ;
52AE 3E00      01410 EQ:     LD A,0             ;(HL)=(DE), SO RETURN 0
               01420 ;
52B0 C1        01430 CSEXIT: POP BC
52B1 C9        01440         RET
               01450 ;
               01460 ;
               01470 ;       DSPSTR: DISPLAY STRING
               01480 ;       ENTRY: HL POINTS TO START OF STRING
               01490 ;       EXIT:  HL POINTS TO EOS
               01500 ;
52B2 F5        01510 DSPSTR: PUSH AF
52B3 7E        01520 DSLP:   LD A,(HL)          ;WHILE (HL)<>EOS
52B4 FE00      01530         CP EOS
52B6 CAC052    01540         JP Z,DSEXIT
52B9 CD3300    01550         CALL DSPC          ;DISPLAY CHAR
52BC 23        01560         INC HL
52BD C3B352    01570         JP DSLP
52C0 F1        01580 DSEXIT: POP AF
52C1 C9        01590         RET
               01600 ;
               01610 ;
               01620 ;       HELP LIST
               01630 ;       EACH HELP LIST ENTRY IS FORMATTED AS FOLLOWS:
               01640 ;       <KEYWORD STRING> <HELP MESSAGE STRING>
               01650 ;
52C2           01660 HLPLST  EQU $
52C2 00        01670         DEFB EOS
52C3 00        01680         DEFB EOS
52C4 48        01690         DEFM 'HELP V1.1  25-JUL-82'
52D8 0D        01700         DEFB CR
52D9 0D        01710         DEFB CR
52DA 54        01720         DEFM 'TO GET HELP ON ONE OF THE FOLLOWING '
52FE 43        01730         DEFM 'COMANDS'
5305 0D        01740         DEFB CR
5306 54        01750         DEFM 'TYPE "HELP <COMMAND>":'
531C 0D        01760         DEFB CR
531D 0D        01770         DEFB CR
531E 41        01780         DEFM 'APPEND   AUTO     ATTRIB   BASIC
```

```
5341 42       Ø179Ø          DEFM 'BASIC2   BASICR'
535Ø ØD       Ø18ØØ          DEFB CR
5351 43       Ø181Ø          DEFM 'CLOCK    COPY     DATE     DEBUG    '
5374 44       Ø182Ø          DEFM 'DEVICE   DIR'
538Ø ØD       Ø183Ø          DEFB CR
5381 44       Ø184Ø          DEFM 'DUMP     KILL     FREE     LIB      '
53A4 4C       Ø185Ø          DEFM 'LIST     LOAD'
53B1 ØD       Ø186Ø          DEFB CR
53B2 5Ø       Ø187Ø          DEFM 'PRINT    PROT     RENAME   TIME     '
53D5 54       Ø188Ø          DEFM 'TRACE    VERIFY'
53E4 ØD       Ø189Ø          DEFB CR
53E5 ØD       Ø19ØØ          DEFB CR
53E6 2Ø       Ø191Ø          DEFM '   < > INDICATE OPTIONAL VALUES'
54Ø3 ØD       Ø192Ø          DEFB CR
54Ø4 2Ø       Ø193Ø          DEFM '    /  INDICATES CHOICE OF VALUES'
5423 ØØ       Ø194Ø          DEFB EOS
              Ø195Ø ;
5424 41       Ø196Ø          DEFM 'APPEND'
542A ØØ       Ø197Ø          DEFB EOS
542B 41       Ø198Ø          DEFM 'APPEND FILE1 TO FILE2'
544Ø ØD       Ø199Ø          DEFB CR
5441 ØD       Ø2ØØØ          DEFB CR
5442 2Ø       Ø2Ø1Ø          DEFM '  ADDS FILE1 ONTO THE END OF FILE2'
5463 ØØ       Ø2Ø2Ø          DEFB EOS
              Ø2Ø3Ø ;
5464 41       Ø2Ø4Ø          DEFM 'AUTO'
5468 ØØ       Ø2Ø5Ø          DEFB EOS
5469 41       Ø2Ø6Ø          DEFM 'AUTO COMMAND'
5475 ØD       Ø2Ø7Ø          DEFB CR
5476 ØD       Ø2Ø8Ø          DEFB CR
5477 2Ø       Ø2Ø9Ø          DEFM '  SPECIFIES A COMMAND TO BE EXECUTED '
549B 57       Ø21ØØ          DEFM 'WHEN DOS IS BOOTED'
54AD ØØ       Ø211Ø          DEFB EOS
              Ø212Ø ;
54AE 41       Ø213Ø          DEFM 'ATTRIB'
54B4 ØØ       Ø214Ø          DEFB EOS
54B5 41       Ø215Ø          DEFM 'ATTRIB FILESPEC <(PARM...PARM)>'
54D4 ØD       Ø216Ø          DEFB CR
54D5 ØD       Ø217Ø          DEFB CR
54D6 2Ø       Ø218Ø          DEFM '  ALTERS PROTECTION STATUS OF FILESPEC'
54FB ØD       Ø219Ø          DEFB CR
54FC 2Ø       Ø22ØØ          DEFM '  FOR MORE INFORMATION TYPE "HELP '
551D 41       Ø221Ø          DEFM 'ATTRIB PARM"'
5529 ØØ       Ø222Ø          DEFB EOS
              Ø223Ø ;
552A 41       Ø224Ø          DEFM 'ATTRIB PARM'
5535 ØØ       Ø225Ø          DEFB EOS      ;2ND LEVEL ENTRY
5536 41       Ø226Ø          DEFM 'ATTRIB COMMAND PARAMETERS:'
555Ø ØD       Ø227Ø          DEFB CR
5551 ØD       Ø228Ø          DEFB CR
5552 2Ø       Ø229Ø          DEFM '  I              MAKE FILE INVISIBLE'
5573 ØD       Ø23ØØ          DEFB CR
5574 2Ø       Ø231Ø          DEFM '  ACC=PSW1       ACCESS PASSWORD = PSW1'
5598 ØD       Ø232Ø          DEFB CR
5599 2Ø       Ø233Ø          DEFM '  UPD=PSW2       UPDATE PASSWORD = PSW2'
55BD ØD       Ø234Ø          DEFB CR
55BE 2Ø       Ø235Ø          DEFM '  PROT=LVL       ACCESS LEVEL = LVL'
55DE ØD       Ø236Ø          DEFB CR
55DF 2Ø       Ø237Ø          DEFM '                 LVL: '
55F2 4B       Ø238Ø          DEFM 'KILL/RENAME/WRITE/READ/EXEC'
```

Program continued

```
560Ø ØØ        Ø239Ø          DEFB EOS
                Ø24ØØ ;
560E 42         Ø241Ø          DEFM 'BASIC'
5613 ØØ         Ø242Ø          DEFB EOS
5614 42         Ø243Ø          DEFM 'BASIC <*>'
561D ØD         Ø244Ø          DEFB CR
561E ØD         Ø245Ø          DEFB CR
561F 2Ø         Ø246Ø          DEFM '  LOADS THE DISK BASIC INTERPRETER.'
5641 ØD         Ø247Ø          DEFB CR
5642 2Ø         Ø248Ø          DEFM '  BASIC * RETURNS TO BASIC WITHOUT '
5664 44         Ø249Ø          DEFM 'DESTROYING PROGRAM'
5676 ØØ         Ø25ØØ          DEFB EOS
                Ø251Ø ;
5677 42         Ø252Ø          DEFM 'BASIC2'
567D ØØ         Ø253Ø          DEFB EOS
567E 42         Ø254Ø          DEFM 'BASIC2'
5684 ØD         Ø255Ø          DEFB CR
5685 ØD         Ø256Ø          DEFB CR
5686 2Ø         Ø257Ø          DEFM '  RETURNS TO LEVEL II (NON-DISK) BASIC '
56AC 49         Ø258Ø          DEFM 'INTERPRETER'
56B7 ØØ         Ø259Ø          DEFB EOS
                Ø26ØØ ;
56B8 42         Ø261Ø          DEFM 'BASICR'
56BE ØØ         Ø262Ø          DEFB EOS
56BF 42         Ø263Ø          DEFM 'BASIC <*>'
56C8 ØD         Ø264Ø          DEFB CR
56C9 ØD         Ø265Ø          DEFB CR
56CA 2Ø         Ø266Ø          DEFM '  SAME AS BASIC BUT INCLUDES '
56E6 52         Ø267Ø          DEFM 'RENUMBERING CAPABILITY'
56FC ØØ         Ø268Ø          DEFB EOS
                Ø269Ø ;
56FD 43         Ø27ØØ          DEFM 'CLOCK'
57Ø2 ØØ         Ø271Ø          DEFB EOS
57Ø3 43         Ø272Ø          DEFM 'CLOCK <(ON/OFF)>'
5713 ØD         Ø273Ø          DEFB CR
5714 ØD         Ø274Ø          DEFB CR
5715 2Ø         Ø275Ø          DEFM '  TURNS REAL-TIME CLOCK DISPLAY ON OR '
573A 4F         Ø276Ø          DEFM 'OFF'
573D ØØ         Ø277Ø          DEFB EOS
                Ø278Ø ;
573E 43         Ø279Ø          DEFM 'COPY'
5742 ØØ         Ø28ØØ          DEFB EOS
5743 43         Ø281Ø          DEFM 'COPY FILE1 TO FILE2'
5756 ØD         Ø282Ø          DEFB CR
5757 ØD         Ø283Ø          DEFB CR
5758 2Ø         Ø284Ø          DEFM '  MAKES A DUPLICATE COPY OF FILE1 '
5779 43         Ø285Ø          DEFM 'CALLED FILE2'
5785 ØØ         Ø286Ø          DEFB EOS
                Ø287Ø ;
5786 44         Ø288Ø          DEFM 'DATE'
578A ØØ         Ø289Ø          DEFB EOS
578B 44         Ø29ØØ          DEFM 'DATE MM/DD/YY'
5798 ØD         Ø291Ø          DEFB CR
5799 ØD         Ø292Ø          DEFB CR
579A 2Ø         Ø293Ø          DEFM '  SETS SYSTEM DATE'
57AB ØØ         Ø294Ø          DEFB EOS
                Ø295Ø ;
57AC 44         Ø296Ø          DEFM 'DEBUG'
57B1 ØØ         Ø297Ø          DEFB EOS
57B2 44         Ø298Ø          DEFM 'DEBUG <(ON/OFF)>'
57C2 ØD         Ø299Ø          DEFB CR
```

```
57C3 ØD        Ø3ØØØ          DEFB CR
57C4 2Ø        Ø3Ø1Ø          DEFM '  ACTIVATES OR DEACTIVATES DEBUGGING '
57E8 4D        Ø3Ø2Ø          DEFM 'MONITOR'
57EF ØD        Ø3Ø3Ø          DEFB CR
57FØ 2Ø        Ø3Ø4Ø          DEFM '  FOR MORE INFORMATION TYPE "HELP DEBUG '
5817 43        Ø3Ø5Ø          DEFM 'COMMANDS"'
582Ø ØØ        Ø3Ø6Ø          DEFB EOS
               Ø3Ø7Ø ;
5821 44        Ø3Ø8Ø          DEFM 'DEBUG COMMANDS'
582F ØØ        Ø3Ø9Ø          DEFB EOS
583Ø 2Ø        Ø31ØØ          DEFM '  DEBUG COMMANDS:
584Ø ØD        Ø311Ø          DEFB CR
5841 2Ø        Ø312Ø          DEFM '  A           SETS DISPLAY TO ASCII '
5865 46        Ø313Ø          DEFM 'FORMAT'
586B ØD        Ø314Ø          DEFB CR
586C 2Ø        Ø315Ø          DEFM '  C           SINGLE STEP, EXECUTE CALLS'
5894 ØD        Ø316Ø          DEFB CR
5895 2Ø        Ø317Ø          DEFM '  D ADR       DISPLAY MEMORY STARTING '
58BB 41        Ø318Ø          DEFM 'AT ADR'
58C1 ØD        Ø319Ø          DEFB CR
58C2 2Ø        Ø32ØØ          DEFM '  G A1,B1,B2  JUMP TO A1; B1 & B2 ARE '
58E8 4F        Ø321Ø          DEFM 'OPT. BREAKPOINTS'
58F8 ØD        Ø322Ø          DEFB CR
58F9 2Ø        Ø323Ø          DEFM '  H           SETS DISPLAY TO '
5917 48        Ø324Ø          DEFM 'HEXADECIMAL FORMAT'
5929 ØD        Ø325Ø          DEFB CR
592A 2Ø        Ø326Ø          DEFM '  I           SINGLE STEP'
5943 ØD        Ø327Ø          DEFB CR
5944 2Ø        Ø328Ø          DEFM '  M ADR       MODIFY MEMORY STARTING AT '
596C 41        Ø329Ø          DEFM 'ADR'
596F ØD        Ø33ØØ          DEFB CR
597Ø 2Ø        Ø331Ø          DEFM '  R RP VAL    LOADS VAL INTO REGISTER '
5996 5Ø        Ø332Ø          DEFM 'PAIR RP'
599D ØD        Ø333Ø          DEFB CR
599E 2Ø        Ø334Ø          DEFM '  S           SETS DISPLAY TO FULL '
59C1 53        Ø335Ø          DEFM 'SCREEN MODE'
59CC ØD        Ø336Ø          DEFB CR
59CD 2Ø        Ø337Ø          DEFM '  U           SETS DYNAMIC DISPLAY '
59FØ 55        Ø338Ø          DEFM 'UPDATE MODE'
59FB ØD        Ø339Ø          DEFB CR
59FC 2Ø        Ø34ØØ          DEFM '  X           SETS DISPLAY TO REGISTER '
5A23 46        Ø341Ø          DEFM 'FORMAT'
5A29 ØD        Ø342Ø          DEFB CR
5A2A 2Ø        Ø343Ø          DEFM '  ;/-         INCREMENTS/DECREMENTS PAGE'
5A52 ØØ        Ø344Ø          DEFB EOS
               Ø345Ø ;
5A53 44        Ø346Ø          DEFM 'DEVICE'
5A59 ØØ        Ø347Ø          DEFB EOS
5A5A 44        Ø348Ø          DEFM 'DEVICE'
5A6Ø ØD        Ø349Ø          DEFB CR
5A61 ØD        Ø35ØØ          DEFB CR
5A62 2Ø        Ø351Ø          DEFM '  LISTS ALL CURRENTLY DEFINED I/O '
5A83 44        Ø352Ø          DEFM 'DEVICES'
5A8A ØØ        Ø353Ø          DEFB EOS
               Ø354Ø ;
5A8B 44        Ø355Ø          DEFM 'DIR'
5A8E ØØ        Ø356Ø          DEFB EOS
5A8F 44        Ø357Ø          DEFM 'DIR <:D> (<S,I,A>)'
5AA1 ØD        Ø358Ø          DEFB CR
5AA2 ØD        Ø359Ø          DEFB CR
5AA3 2Ø        Ø36ØØ          DEFM '  DISPLAYS DIRECTORY OF DISK IN DRIVE :D'
```

Program continued

```
5ACA ØD           DEFB CR
5ACB 2Ø           DEFM '  FOR MORE INFORMATION TYPE "HELP DIR '
5AFØ 4F           DEFM 'OPT"'
5AF4 ØØ           DEFB EOS
                ;
5AF5 44           DEFM 'DIR OPT'
5AFC ØØ           DEFB EOS
5AFD 44           DEFM 'DIR OPTIONS:'
5BØ9 ØD           DEFB CR
5BØA ØD           DEFB CR
5BØB 2Ø           DEFM '  S  DISPLAY ALL SYSTEM AND '
5B26 4E           DEFM 'NON-INVISIBLE FILES'
5B39 ØD           DEFB CR
5B3A 2Ø           DEFM '  I  DISPLAY ALL INVISIBLE AND '
5B58 4E           DEFM 'NON-SYSTEM FILES'
5B68 ØD           DEFB CR
5B69 2Ø           DEFM '  A  DISPLAY DISK SPACE ALLOCATION'
5B8A ØØ           DEFB EOS
                ;
5B8B 44           DEFM 'DUMP'
5B8F ØØ           DEFB EOS
5B9Ø 44           DEFM 'DUMP FILE (START=X''AAAA'',END=X''BBBB'''
5BA2 3C           DEFM '<,TRA=X''CCCC''>)'
5BA9 ØD           DEFB CR
5BAA ØD           DEFB CR
5BAB 2Ø           DEFM '  DUMPS MEMORY FROM ADDRESS AAAA TO '
5BCE 42           DEFM 'BBBB TO DISK,'
5BDB ØD           DEFB CR
5BDC 2Ø           DEFM '  WITH FILESPEC "FILE".  WHEN FILE IS '
5CØ1 4C           DEFM 'LOADED, EXECUTION'
5C12 ØD           DEFB CR
5C13 2Ø           DEFM '  WILL BEGIN AT ADDRESS CCCC (IF '
5C33 53           DEFM 'SUPPLIED)'
5C3C ØØ           DEFB EOS
                ;
5C3D 46           DEFM 'FREE'
5C41 ØØ           DEFB EOS
5C42 46           DEFM 'FREE'
5C46 ØD           DEFB CR
5C47 ØD           DEFB CR
5C48 2Ø           DEFM '  DISPLAYS FREE SPACE ON ALL DISKS'
5C69 ØØ           DEFB EOS
                ;
5C6A 4B           DEFM 'KILL'
5C6E ØØ           DEFB EOS
5C6F 4B           DEFM 'KILL FILESPEC'
5C7C ØD           DEFB CR
5C7D ØD           DEFB CR
5C7E 2Ø           DEFM '  DELETES FILESPEC FROM DISK'
5C99 ØØ           DEFB EOS
                ;
5C9A 4C           DEFM 'LIB'
5C9D ØØ           DEFB EOS
5C9E 4C           DEFM 'LIB'
5CA1 ØD           DEFB CR
5CA2 ØD           DEFB CR
5CA3 2Ø           DEFM '  DISPLAYS NAMES OF DOS COMMANDS'
5CC2 ØØ           DEFB EOS
                ;
5CC3 4C           DEFM 'LIST'
5CC7 ØØ           DEFB EOS
```

```
5CC8 4C         04220           DEFM 'LIST FILESPEC'
5CD5 0D         04230           DEFB CR
5CD6 0D         04240           DEFB CR
5CD7 20         04250           DEFM '  DISPLAYS CONTENTS OF FILESPEC ON '
5CF9 53         04260           DEFM 'SCREEN'
5CFF 00         04270           DEFB EOS
                04280 ;
5D00 4C         04290           DEFM 'LOAD'
5D04 00         04300           DEFB EOS
5D05 4C         04310           DEFM 'LOAD FILESPEC'
5D12 0D         04320           DEFB CR
5D13 0D         04330           DEFB CR
5D14 20         04340           DEFM '  LOADS FILESPEC FROM DISK TO MEMORY'
5D37 00         04350           DEFB EOS
                04360 ;
5D38 50         04370           DEFM 'PRINT'
5D3D 00         04380           DEFB EOS
5D3E 50         04390           DEFM 'PRINT FILESPEC'
5D4C 0D         04400           DEFB CR
5D4D 0D         04410           DEFB CR
5D4E 20         04420           DEFM '  PRINTS CONTENTS OF FILESPEC ON PRINTER'
5D75 00         04430           DEFB EOS
                04440 ;
5D76 50         04450           DEFM 'PROT'
5D7A 00         04460           DEFB EOS
5D7B 50         04470           DEFM 'PROT <:D> <(PARM...PARM)>'
5D94 0D         04480           DEFB CR
5D95 0D         04490           DEFB CR
5D96 20         04500           DEFM '  CHANGES PROTECTION STATUS OF ALL '
5DB8 46         04510           DEFM 'FILES ON DRIVE :D'
5DC9 0D         04520           DEFB CR
5DCA 20         04530           DEFM '  FOR MORE INFORMATION TYPE "HELP PROT '
5DF0 50         04540           DEFM 'PARM"'
5DF5 00         04550           DEFB EOS
                04560 ;
5DF6 50         04570           DEFM 'PROT PARM'
5DFF 00         04580           DEFB EOS
5E00 50         04590           DEFM 'PROT PARAMETERS:'
5E10 0D         04600           DEFB CR
5E11 0D         04610           DEFB CR
5E12 20         04620           DEFM '  PW      CHANGE MASTER PASSWORD'
5E32 0D         04630           DEFB CR
5E33 20         04640           DEFM '  UNLOCK  REMOVE PASSWORDS FROM USER '
5E58 46         04650           DEFM 'FILES'
5E5D 0D         04660           DEFB CR
5E5E 20         04670           DEFM '  LOCK    ASSIGN MASTER PASSWORD TO '
5E82 55         04680           DEFM 'USER FILES'
5E8C 00         04690           DEFB EOS
                04700 ;
5E8D 52         04710           DEFM 'RENAME'
5E93 00         04720           DEFB EOS
5E94 52         04730           DEFM 'RENAME FILE1 TO FILE2'
5EA9 0D         04740           DEFB CR
5EAA 0D         04750           DEFB CR
5EAB 20         04760           DEFM '  CHANGES NAME OF FILE1 TO FILE2'
5ECA 00         04770           DEFB EOS
                04780 ;
5ECB 54         04790           DEFM 'TIME'
5ECF 00         04800           DEFB EOS
5ED0 54         04810           DEFM 'TIME HH:MM:SS'
5EDD 0D         04820           DEFB CR
```

Program continued

```
5EDE ØD        Ø483Ø          DEFB CR
5EDF 2Ø        Ø484Ø          DEFM '  SETS REAL TIME CLOCK'
5EF4 ØØ        Ø485Ø          DEFB EOS
               Ø486Ø ;
5EF5 54        Ø487Ø          DEFM 'TRACE'
5EFA ØØ        Ø488Ø          DEFB EOS
5EFB 54        Ø489Ø          DEFM 'TRACE <(ON/OFF)>'
5FØB ØD        Ø49ØØ          DEFB CR
5FØC ØD        Ø491Ø          DEFB CR
5FØD 2Ø        Ø492Ø          DEFM '  SETS DISPLAY OF PC REGISTER ON OR OFF'
5F33 ØØ        Ø493Ø          DEFB EOS
               Ø494Ø ;
5F34 56        Ø495Ø          DEFM 'VERIFY'
5F3A ØØ        Ø496Ø          DEFB EOS
5F3B 56        Ø497Ø          DEFM 'VERIFY <(ON/OFF)>'
5F4C ØD        Ø498Ø          DEFB CR
5F4D ØD        Ø499Ø          DEFB CR
5F4E 2Ø        Ø5ØØØ          DEFM '  SETS DISK WRITE VERIFICATION ON OR OFF'
5F75 ØØ        Ø5Ø1Ø          DEFB EOS
               Ø5Ø2Ø ;
5F76           Ø5Ø3Ø ENDLST   EQU $
5F76 53        Ø5Ø4Ø NFMSG:   DEFM 'SORRY -- NO HELP IS AVAILABLE FOR '
5F98 ØØ        Ø5Ø5Ø          DEFB EOS
5F99           Ø5Ø6Ø KEYWRD   EQU $
               Ø5Ø7Ø ;
52ØØ           Ø5Ø8Ø          END HELP
ØØØØØ TOTAL ERRORS
```

Program Listing 2

```
;
;       HELP LIST
;       EACH HELP LIST ENTRY IS FORMATTED AS FOLLOWS:
;       <KEYWORD STRING> <HELP MESSAGE STRING>
;
HLPLST  EQU $           ;THIS MARKS START OF HELP LIST
        DEFB EOS
        DEFB EOS
        DEFM 'HELP V1.1  25-JUL-82'
        DEFB CR
        DEFB CR
        DEFM 'THIS IS EXAMPLE 1.'
        DEFB CR
        DEFM 'THESE NAMES ARE KEYWORDS IN A SAMPLE'
        DEFB CR
        DEFM 'NAME AND ADDRESS LIST:'
        DEFB CR
        DEFB CR
        DEFM 'ALICE ARMSTRONG, MARY SMITH, BRIDGET TURNER'
        DEFB CR
        DEFM 'SHARON WILLIAMS'
        DEFB CR
        DEFB CR
        DEFM 'TO FIND AN ADDRESS AND PHONE NUMBER, TYPE'
        DEFB CR
        DEFM '  "HELP <NAME>"'
        DEFB EOS
;
```

```
        DEFM 'ALICE ARMSTRONG'  ;THIS IS THE KEYWORD
        DEFB EOS                ;EOS MARKS END OF KEYWORD
                                ;INFO FOR ALICE A. FOLLOWS
        DEFM 'ALICE ARMSTRONG'
        DEFB CR
        DEFM '377 OCTAL AVENUE'
        DEFB CR
        DEFM 'TROIS-RIVERES, QUEBEC'
        DEFB CR
        DEFM 'PHONE: 745-1263'
        DEFB EOS                ;EOS MARKS END OF INFO
;
        DEFM 'MARY SMITH'
        DEFB EOS
        DEFM 'MARY SMITH'
        DEFB CR
        DEFM '111 1ST STREET'
        DEFB CR
        DEFM 'ATOWN, WHEREVER'
        DEFB CR
        DEFM 'PHONE: 123-4567'
        DEFB EOS
;
        DEFM 'BRIDGET TURNER'
        DEFB EOS
        DEFM 'BRIDGET TURNER'
        DEFB CR
        DEFM '2 RADIUS CIRCLE'
        DEFB CR
        DEFM 'COMPASS, ONTARIO'
        DEFB CR
        DEFM 'PHONE: 314-1592'
        DEFB EOS
;
        DEFM 'SHARON WILLIAMS'
        DEFB EOS
        DEFM 'SHARON WILLIAMS'
        DEFB CR
        DEFM '8080 PROCESSOR BLVD'
        DEFB CR
        DEFM 'MEMORY LAKE, MANITOBA'
        DEFB CR
        DEFM 'PHONE: 280-4116'
        DEFB EOS
;
ENDLST  EQU $           ;THIS MARKS THE END OF HELP LIST
```

17

Automatic Master Disk Directory

by Jack R. Smith

System Requirements:
Model III
One disk drive
TRSDOS-compatible DOS
Printer optional

Do you get tired of thumbing through your collection of disks looking for a particular program? My program, INDEX, automatically reads the directory information from each disk, then sorts and saves the information on a master disk program index.

The basis of the first, extraction part of INDEX is a machine-language TRSDOS RAM call, $RAMDIR, which allows you to examine a disk directory one entry at a time or altogether. $RAMDIR is an easy routine to invoke from BASIC. Set the HL, B, and C registers of the Z80 to the initial condition described in the *Model III Disk System Owner's Manual* (Figure 1). $RAMDIR is then called with a USR 0 instruction. When the directory has been written into the specified memory locations, control is returned to the BASIC interpreter.

The initialization, calling and return functions are accomplished in the short assembler program shown in Program Listing 1. Line 100 exchanges the register set in current use with the alternate set (the prime registers), saving the contents of the normal register set. Line 110 loads the HL register pair with the starting address of the memory location where the directory information is to be placed.

Since approximately 1761 bytes of directory information have to be accommodated, as well as the calling program, a 48K machine should start storing the directory about 2000 bytes below the top of the memory, or at F700H. Line 120 tells the routine to read the directory using drive 1. Line 130 selects transfer of the entire directory into memory. Line 140 transfers control to the $RAMDIR routine. Line 150 restores the normal regis-

ter set of the Z80 so that return to BASIC is possible without loss of information. Line 160 returns control to the BASIC interpreter.

The directory information is written sequentially into memory, starting with the address loaded into the HL register. According to Radio Shack, this directory information is written in blocks 21 bytes in length, in the format FILENAME/EXT:DR, left justified, and padded with trailing blanks for a length of 15 bytes, followed by the file's protection level information, its length, and other information which is not of interest here (see Figure 2).

Register	Contents	Purpose
HL	F700H	Points to start of destination address of directory information F700H for 64K machines.
B	1H	Drive to be read from
C	0H	Switch—0H copies entire directory

Figure 1. *Entry conditions to $RAMDIR*

A
File names without /EXT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
						Filename:d								P	E	L	S		G	

B
File names with /EXT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
						Filename:d									P	E	L	S		G	

P: Protection Level
E: End of File
L: Logical Record Length
S: Last Sector in File
G: Number of Granules in File

Figure 2. *Directory files returned by $RAMDIR*

FILENAME/EXT is the user-generated file name and optional extension under which the program is stored. DR is the drive number that the disk is read from, in this case drive number 1. A program saved with the command SAVE "HELLO/BAS" is transferred into memory by $RAMDIR as HELLO/BAS:1bbbbXXXXXXX, where b indicates a blank and X stands for numeric information not used in the indexing program. The last entry in the directory is a plus sign (+).

Any file stored with an extension takes 22 characters, while file names without an extension are transferred into memory using 21 characters. Consequently, each directory entry must be examined for a slash (/),

which if found tells the program that the start of the next directory entry is found 22 characters after the file under examination. If no slash is found, then the next file entry begins 21 characters later.

The second part of the program reads the resulting files into the array A$(n), sorts the array, and prints the sorted array. Disks are identified with a user-supplied two-digit serial number from 01 to 99, which is then appended to the FILENAME/EXT extracted from the first part of the program. After the program has read the last disk, a dummy disk number of 0 is entered and control branches to the print routine.

To speed up the sort, I use the TRSDOS CMD"O" machine-language sort routine, which takes only five seconds to sort 400 entries. Since printing 400 directory entries—one per line—would use seven pages, I use a 4-column format, which resembles a dictionary in layout and permits the same amount of information to be contained on two pages. The print parameters are based on an Epson MX-100 printer, with automatic page performation skip.

Operating the program is simple. The program assumes that you have numbered each of your disks with a different ID number between 1 and 99. INDEX also requires that you leave a TRSDOS system disk in drive 0 while the program is reading your disk from drive 1. If you wish to read the disk that is in drive 0, substitute any other TRSDOS system disk.

When the program is run, it asks for the ID number of the first disk to be read, then if that disk is mounted on drive number 1. If your reply is Y, the directory is read and the directory names are displayed on the screen as they are read from memory by the program. When the last name has been read, you are asked for the next disk ID number. If no more disks are to be read, type 0 as an ID, and an alphabetized master directory will be printed as hard copy.

Program Analysis

Lines 100–160: Initialize program, set MEMSIZE

Lines 170–240: Set up disk ID and make sure disk is mounted.

Lines 250–330: Line 250 tells the BASIC program the address to transfer control to when the machine-language routine is called. Lines 260–330 are the machine-language routine and the POKE statements for putting it into memory.

Line 340: Calls the machine-language routine.

Lines 500–520: Initialize the memory reading section.

Lines 530–610: Examine the memory, byte by byte. Non-printing characters are stripped, and the colon (:) delimiter is searched for. Control is transferred out of the loop when each FILENAME/EXT is read or when the end of directory is reached.

Lines 1000–1030: Prompt operator for all disks after the first one.

Lines 1200–1270: Subroutine which is called after a complete record

has been found in lines 530–610. The end of a record is identified by a colon (:). The disk ID is added to the file name and the resulting string stored in A$(K). Based on the presence or absence of a slash (/), the next file name is looked for 21 or 22 characters after the start of the file name which has just been completed.

Lines 4000–4060: Print a header at the top of the page in double wide characters, and the date of the run.

Line 4070: Activates automatic page perforation skip feature of Epson printers.

Lines 4080–4100: Use TRSDOS utility sort routine.

Lines 4110–4180: Break the sorted array into quarters, and then print the four columns.

Changes for 32K Machines

Line 130 POKE 16562,&HF7 : POKE 16561,&HB7
Line 140 CLEAR 12000
Line 250 DEFUSR0=&HBF00
Line 260 DATA 217,33,248,183,6,
 1,14,0,205,144,66,217,201
Line 310 POKE (&HBF00+X),P
Line 530 A$=CHR$(PEEK(&HB7F8+NN))

Changes for Other 132-Column Printers

Line 4030 LPRINT TAB(53) "MASTER DISK INDEX LIST"
Line 4070 Delete this line.

Program Listing 1. *$RAMDIR calling program*

```
0000 D9          00100        EXX                       ;SWAP REGISTERS
0001 2100F7      00110        LD      HL,0F700H         ;LOAD WITH START ADDRESS
0004 0601        00120        LD      B,1               ;USE DRIVE NUMBER 1
0006 0E00        00130        LD      C,0               ;GET ENTIRE DIRECTORY
0008 CD9044      00140        CALL    4490H             ;CALL $RAMDIR
000B D9          00150        EXX                       ;SWAP REGISTERS BACK
000C C9          00160        RET                       ;BACK TO BASIC
0000             00170        END
00000 TOTAL ERRORS
```

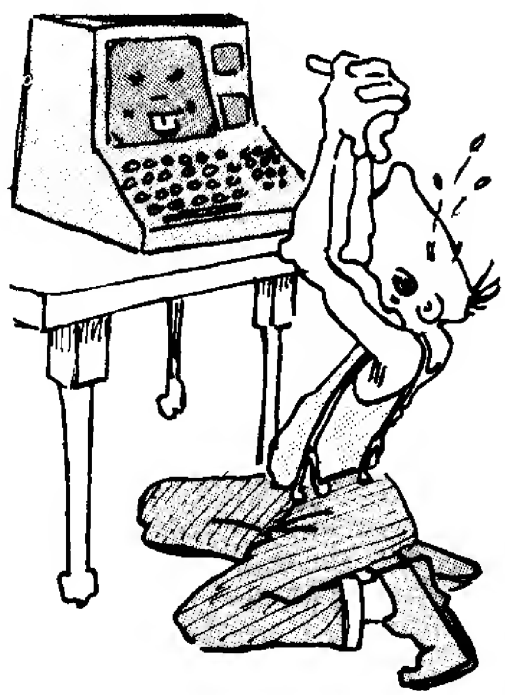
Program Listing 2. *INDEX*

```
100 'MODEL III DISK INDEXER
110 'BY JACK R. SMITH K8ZOA
120 'VERSION 1.0  APRIL 11,1982
125 'NO NEED TO SET MEM SIZE
130 POKE 16562,&HF6 : POKE 16561,&HFF:
```

Program continued

```
     'SETS MEMSIZE
135 'IF 32K POKE 16562,&HB7 : POKE 16561,&HF8
140 CLEAR 22000

        :'(48K) IF 32K CLEAR 12000
150 DIM A$(1200)          :'A$ HOLDS PROGRAM NAMES
160 CLS
170 PRINT@512,"";:INPUT "ENTER DISK ID NUMBER ";ID
180 IF ID<0 OR ID>99 THEN GOTO 160
190 IF ID=0 THEN GOTO 4000
200 ID$=STR$(ID)          :'CONVERT ID NO. TO STRING
210 PRINT@ 512, STRING$(60,32)
220 PRINT@512,"IS DISK NUMBER" ID$ ;:INPUT " MOUNTED ON DRIVE #1
";Y$
230 IF LEFT$(Y$,1)<>"Y" THEN GOTO 210
240 '
250 DEFUSR0=&HFF00
255 ' IF 32K THEN DEFUSR0=&HBF00
260 DATA 217,33,0,247,6,1,14,0,205,144,66,217,201
270 'LINE 260 FOR 48K IF 32K CHANGE TO
280 'DATA 217,33,248,183,6,1,14,0,205,144,66,217,201
290 FOR X=0 TO 12         :'POKE INTO HIGH MEMORY
300     READ P
310     POKE (&HFF00+X),P        :'CHANGE TO &HBF00 IF 32K
320     NEXT X
330 RESTORE                      :'FOR NEXT DISK
340 J=USR0(0)                    :'LOAD DIRECTORY INTO MEMORY
350 '
500 ' READ DIRECTORY INFORMATION FROM MEMORY AND PUT INTO A$( )
505 PRINT@512,STRING$(60,32)
510 M=0          :'POSITION COUNTER
520 NN=M         :'CHARACTER COUNTER
530 A$=CHR$(PEEK(&HF700+NN))     :'LOOK AT DIRECTORY ONE CHR AT A
 TIME
535 ' IF 32K THEN PEEK(&HB7F8+NN)
540  IF A$<"!" THEN A$=""        :'CLEAN OUT NONPRINT CHRS.
550 IF A$>"Z" THEN A$=""         :'DITTO
560 NN=NN+1                      :'ADVANCE COUNTER
570 IF A$="+" THEN GOTO 1000     :'END OF DIRECTORY MARKED BY ++
580 IF A$=":" THEN GOSUB 1200 : GOTO 520        :'END OF RECORD
590 B$=B$+A$
600 PRINT@512,B$
610 GOTO 530                     :READY FOR NEXT CHARACTER
1000 CLS
1010 PRINT@512,"LOAD NEXT DISK INTO DRIVE #1."
1020 PRINT@576,"ENTER DISK ID NUMBER OR 0 TO HARDCOPY SORTED LIS
T";:INPUTID
1030 GOTO 180
1200 CLS
1210 'PUT RECORD INTO A$( )
1220 A$(K)=B$+ ":" + ID$        :'RECORD FORMAT FILENAM/EXT :ID
1230 K=K+1
1235 ' TRSDOS HAS TWO LENGTHS -- 21 IF NO /EXT AND 22 IF USE /EX
T
1240 IF INSTR(B$,"/")=0 THEN M=M+21 ELSE M=M+22
1250 B$=""       :'READY FOR NEXT RECORD
1260 PRINT@512,STRING$(60,32)
1270 RETURN
4000 CLS
4010 'PRINT AND SORT SECTION
4020 'WRITTEN FOR EPSON MX-100 PRINTER
```

```
4030 LPRINT TAB(44) CHR$(14) CHR$(155) "E" "MASTER DISK INDEX LI
ST" CHR$(18) CHR$(155) "F" :'DOUBLE WIDE DOUBLE STRIKE HEADER
4040 LPRINT STRING$(2,10)
4050 LPRINT "DATE PREPARED: "LEFT$(TIME$,8)
4060 LPRINT STRING$(2,10)
4070 LPRINT CHR$(155) "N"      :'AUTO PAGE SKIP WITH EPSON
4080 N%=K+1
4090 'USE TRSDOS MACHINE SORT ROUTINE
4095 CLS: PRINT@512,"SORTING -- READY PRINTER"
4100 CMD "O",N%,A$(0)
4110 '
4120 K4=INT(K/4)+1      :'FOR FOUR COLUMN ACROSS
4130 FOR L=1 TO K4
4140 SP=33              :'132 COLUMN PRINTER
4150 LPRINT A$(L) TAB(SP) A$(L+K4) TAB(2*SP) A$(L+2*K4) TAB(3*SP
) A$(L+3*K4)
4160 NEXT L
4170 LPRINT CHR$(12)    :'FORM FEED
4180 END
```



18

Short Form Directory

by Salvatore Yorks

System Requirements:
Model III
TRSDOS
One disk drive
Editor/assembler

I've developed a short machine-language program, D/CMD, that uses a simple command to put the BASIC directory on the screen after the TRSDOS READY prompt. This saves you time and frustration when you can't remember how the program name was abbreviated. I keep a copy on every disk I own, usually as an invisible file that is transparent to other users, and cannot be killed accidentally. You can use this program on all existing versions of DOS, 1.1, 1.2, and 1.3.

TRSDOS uses a buffer located at 4225H for all DOS commands. It stops reading a program name when it encounters a space. To use D/CMD, type D, press the space bar,and type 0, 1, 2, or 3. If you call for a directory by pressing D without entering a number, drive 0 is the default drive. The resulting display is the same directory you get when you use the CMD"D:#" command in BASIC. It lists all the program names on any disk together, without scrolling off the screen.

D/CMD is a complete, stand-alone program. It occupies the same area as DEBUG, 5200H-5272H, so no BASIC program resident in memory is disturbed when the directory is called. The code is completely relocatable; you can move it by changing the ORG statement in line 2200 of the assembly listing.

Once you've entered the program using an editor/assembler, you can create a build file, using the BUILD command in TRSDOS. Type BUILD SB and press ENTER. After each prompt, type the following lines:

```
COPY D/CMD:0 :1
ATTRIB D/CMD:1 (I)
D:1
```

Now press the BREAK key and you're ready to update all your disks.

- Place the disk with the BUILD file in drive 0.
- Place the disk to receive D/CMD in drive 1.
- Type DO SD and press ENTER.
- Repeat as often as necessary to convert all disks.
- You might want to set the AUTO function to DO SD and simply press RESET after exchanging disks.

This copies the program from drive 0 to drive 1, then changes the file's visibility so that no one will mistakenly delete it. Then it runs the program from drive 1, to make sure it's there, and has been rendered invisible. Once converted, you can call up a usable directory that won't run off the screen. If you want or need the full file information, you have to run the fill DIR system function.

Program Listing. *Directory Routine*

```
              00200 ;* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
              00300 ;*                                                          *
              00400 ;*               MODEL III - SHORT                          *
              00500 ;*               DIRECTORY ROUTINE                          *
              00600 ;*                    REVISED                               *
              00700 ;*                    07/04/82                              *
              00800 ;*                                                          *
              00900 ;*                                                          *
              01000 ;*                                                          *
              01100 ;*                                                          *
              01200 ;* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
              01300 ;                    DEFINED ADDRESSES
01C9          01400 CLS      EQU     01C9H          ;CLEAR SCREEN .
4271          01500 DRIVE    EQU     4271H          ;POINTER TO DRIVE SELECTED FOR DIRECTORY .
4419          01600 DSPDIR   EQU     4419H          ;DIRECTORY DISPLAY - BASIC FORMAT .
4225          01700 TXT      EQU     4225H          ;DOS TEXT BUFFER .
4290          01800 RAMDIR   EQU     4290H          ;SELECTIVE DIR ENTRY .
0033          01900 VDCHAR   EQU     0033H          ;DISPLAY A SINGLE CHARACTER .
021B          02000 VDLINE   EQU     021BH          ;DISPLAY AN ENTIRE MESSAGE .
4210          02100 SPECL    EQU     4210H          ;SPECIAL CHARACTER SWITCH REGISTER.
5200          02200          ORG     5200H          ;DOS "DEBUG" PROGRAM AREA .
              02300 ;                PROGRAM BEGINS HERE
5200 CDC901   02400 START    CALL    CLS            ;CLEAR THE SCREEN !
5203 3E28     02500          LD      A,40           ;SETS SPECIAL CHARACTERS
5205 321042   02600          LD      (SPECL),A      ;TURNS OFF KANA CHARACTERS!
5208 1600     02700          LD      D,0            ;0'S TO FILL MEMORY .
520A 217042   02800          LD      HL,DRIVE-1     ;START HERE - CLEARS DRIVE POINTER .
520D 010500   02900          LD      BC,5           ;FILL 5 BYTES .
5210 CD7B52   03000          CALL    FILL           ;DO IT TO IT !
5213 010A00   03100          LD      BC,10          ;FILL 10 BYTES .
5216 21C352   03200          LD      HL,FREE        ;START HERE .
5219 CD7B52   03300          CALL    FILL           ; DO IT TO IT AGAIN !
              03400 ;            DISPLAY BASIC FORMAT DIRECTORY
521C 3A2742   03500          LD      A,(TXT+2)      ;GET DRIVE # FROM DOS COMMAND BUFFER .
521F FE31     03600          CP      '1'            ;IS IT A "1" ?
5221 280A     03700          JR      Z,EXE          ;OK      DO IT!
5223 FE32     03800          CP      '2'            ;IS IT A "2" ?
5225 2806     03900          JR      Z,EXE          ;OK      DO IT!
5227 FE33     04000          CP      '3'            ;IS IT A "3" ?
5229 2802     04100          JR      Z,EXE          ;OK      DO IT!
522B 3E30     04200          LD      A,'0'          ;IF IT ISN'T 1,2 OR 3 IT MUST BE 0!
522D 327142   04300 EXE      LD      (DRIVE),A      ;POINT TO TARGET DRIVE .
5230 CD1944   04400          CALL    DSPDIR         ;DISPLAY THE TARGETED DIRECTORY .
```

Program continued

```
                  Ø45ØØ ;                       GET FREE SPACE INFORMATION
5233 21C352       Ø46ØØ           LD      HL,FREE         ;POINT TO FREE SPACE BUFFER .
5236 ØEFF         Ø47ØØ           LD      C,255           ;ASK FOR FREE SPACE INFO .
5238 3A7142       Ø48ØØ           LD      A,(DRIVE)       ;GET DRIVE NUMBER .
523B D630         Ø49ØØ           SUB     3ØH             ;CONVERT TO TRUE HEX VALUE !
523D 47           Ø5ØØØ           LD      B,A             ;GET HEX # INTO B .
523E CD9042       Ø51ØØ           CALL    RAMDIR          ;GET FREE SPACE INFO .
                  Ø52ØØ ;                      DISPLAY DIRECTORY TITLE
5241 218352       Ø53ØØ           LD      HL,MSG1         ;POINT TO FREE SPACE MESSAGE .
5244 CD1BØ2       Ø54ØØ           CALL    VDLINE          ;DISPLAY MESSAGE .
                  Ø55ØØ ;                 CONVERT FREE SPACE INFO FROM HEX TO DECIMAL
5247 2AC552       Ø56ØØ           LD      HL,(FREE+2)     ;GET ASCII INTO HL .
524A DD216E52     Ø57ØØ           LD      IX,DECTBL       ;POINTER .
524E AF           Ø58ØØ PDEC1     XOR     A               ;CLEAR A .
524F DD46Ø1       Ø59ØØ           LD      B,(IX+1)        ; BC HOLDS THE
5252 DD4EØØ       Ø6ØØØ           LD      C,(IX)          ;           DECIMAL DIGIT .
5255 B7           Ø61ØØ           OR      A               ;CLEAR CARRY .
5256 ED42         Ø62ØØ PDEC2     SBC     HL,BC           ;SUBTRACT BC .
5258 38Ø3         Ø63ØØ           JR      C,PDEC3         ;DIGIT DONE .
525A 3C           Ø64ØØ           INC     A               ;ELSE INC A .
525B 18F9         Ø65ØØ           JR      PDEC2           ;CONTINUE .
525D Ø9           Ø66ØØ PDEC3     ADD     HL,BC           ;ADD BACK .
525E C63Ø         Ø67ØØ           ADD     A,3ØH           ;"Ø" TO "9" .
                  Ø68ØØ ;                 DISPLAY DECIMAL FREE SPACE INFO
526Ø CD33ØØ       Ø69ØØ           CALL    VDCHAR          ;DISPLAY IT .
5263 79           Ø7ØØØ           LD      A,C             ;IF C=1
5264 FEØ1         Ø71ØØ           CP      1               ; THEN DONE .
5266 28ØC         Ø72ØØ           JR      Z,DSP           ; DISPLAY REST OF MESSAGE WHEN DEC. CONV. IS DONE .
5268 DD23         Ø73ØØ           INC     IX              ; DONE TWICE BECAUSE
526A DD23         Ø74ØØ           INC     IX              ;    THE TABLE IS STORED IN TWO BYTE WORDS .
526C 18EØ         Ø75ØØ           JR      PDEC1           ; CONTINUE CONVERSION .
526E 64ØØ         Ø76ØØ DECTBL    DEFW    1ØØ             ;TABLE USED FOR DECIMAL
527Ø ØAØØ         Ø77ØØ           DEFW    1Ø              ;CONVERSION .
5272 Ø1ØØ         Ø78ØØ           DEFW    1               ;
                  Ø79ØØ ;                  DISPLAY FREE SPACE MESSAGE
5274 21A852       Ø8ØØØ DSP       LD      HL,MSG2         ;POINT TO NEXT MESSAGE .
5277 CD1BØ2       Ø81ØØ           CALL    VDLINE          ;DISPLAY IT !
                  Ø82ØØ ;                 RETURN TO DISK CALLER WHEN DONE
527A C9           Ø83ØØ           RET                     ;RETURN - DONE
                  Ø84ØØ ;                       FILL MEMORY WITH SPECIFIC BYTE
527B 72           Ø85ØØ FILL      LD      (HL),D          ;STORE THE BYTE TO USE .
527C 23           Ø86ØØ           INC     HL              ;POINT TO NEXT BYTE .
527D ØB           Ø87ØØ           DEC     BC              ;ADJUST THE COUNT .
527E 78           Ø88ØØ           LD      A,B             ;MSB OF COUNT .
527F B1           Ø89ØØ           OR      C               ;MERGE LSB .
528Ø 2ØF9         Ø9ØØØ           JR      NZ,FILL         ;CONTINUE 'TILL DONE .
5282 C9           Ø91ØØ           RET                     ;RETURN WHEN DONE .
                  Ø92ØØ ;                         SCREEN MESSAGE AREA
5283 15           Ø93ØØ MSG1      DEFB    21              ;SWITCH TO SPECIAL CHARACTERS
5284 EE           Ø94ØØ           DEFB    238             ;FAT "X"
5285 EE           Ø95ØØ           DEFB    238             ;FAT "X"
5286 EE           Ø96ØØ           DEFB    238             ;FAT "X"
5287 2Ø           Ø97ØØ           DEFM    ' Model III Short Directory '
52A2 8F           Ø98ØØ           DEFB    143             ;SHIRT CUFF FOR POINTING HAND
52A3 F4           Ø99ØØ           DEFB    244             ;POINTING
52A4 F5           1ØØØØ           DEFB    245             ;     HAND AND
52A5 F6           1Ø1ØØ           DEFB    246             ;        FINGER
52A6 2Ø           1Ø2ØØ           DEFB    2ØH             ;SPACE   .
52A7 Ø3           1Ø3ØØ           DEFB    Ø3H             ;END-OF-MESSAGE TERMINATOR - NO C.R.
52A8 2Ø           1Ø4ØØ MSG2      DEFM    ' Free Gran(s) '
52B6 EE           1Ø5ØØ           DEFB    238             ;FAT "X" FOR BOARDER
52B7 EE           1Ø6ØØ           DEFB    238             ;        FOR
52B8 EE           1Ø7ØØ           DEFB    238             ;          MESSAGE .
52B9 2Ø           1Ø8ØØ           DEFM    ' SLY '         ;I ALWAYS SIGN MY WORK !
52BE EE           1Ø9ØØ           DEFB    238             ;FAT "X" FOR
52BF EE           11ØØØ           DEFB    238             ;     BORDER .
52CØ EE           111ØØ           DEFB    238             ;       AT END OF LINE
52C1 15           112ØØ           DEFB    21              ; SWITCH BACK TO SPACE COMPRESSION CODES
52C2 ØD           113ØØ           DEFB    ØDH             ;END-OF-MESSAGE TERMINATOR - WITH C.R.
                  114ØØ ;                 STORAGE BUFFER FOR FREE SPACE INFORMATION
ØØØA              115ØØ FREE      DEFS    1Ø              ;STORAGE AREA FOR FREE SPACE INFORMATION .
52ØØ              116ØØ           END     START           ;PROGRAM ENDS HERE !
ØØØØØ TOTAL ERRORS
```

19

ONESTEP at a Time in BASIC

by Alan Sehmer

System Requirements:
Model I
32K RAM
Disk BASIC
One disk drive
TRSDOS

Writing a BASIC program is easy; the hard part is making it work. The best way to debug is to run the program one command at a time. ONESTEP lets you run a BASIC program one command at a time, while displaying the current line number and up to 26 user-defined variables. The program may be run at close to normal speed, or at a very slow speed.

Once ONESTEP is entered and loaded, load disk BASIC. Answer the Memory Size? question with 48128 to keep BASIC from overwriting ONESTEP. Load the program you want to debug. To turn ONESTEP on, add this line to the target program: DEFUSR 0=(&HBC00): * = USR 0(0), where the asterisk is a dummy variable. The line can be put anywhere. If you have a long program that runs fine until the last few lines, ONESTEP need not be activated until just before the problem lines.

ONESTEP understands six commands.

SHIFT S	Go into the one-step mode. Print the BASIC line number and the variables requested.
ENTER	Execute the next command. Display line number and variables.
N	Leave the one-step mode. Run program at normal speed. Display line numbers in upper right.
S	Leave the one-step mode. Run program at slow speed. Display line numbers in upper right.
C	Change the variables to monitor.

K Kill ONESTEP. This entirely disconnects ONESTEP. The DEFUSR line must be executed to restart it.

With ONESTEP on, a program can be stopped with the BREAK key only in modes N or S. The program can then be edited or restarted with CONT, RUN or GOTO. It is unwise to stop a program in the S mode; nothing is hurt, but the keyboard is slow to receive input. ONESTEP uses the variables QA$-QZ$ to store the names of the variables to be printed. Because all variables are destroyed by the EDIT, CLEAR and RUN commands, ONESTEP automatically executes a C command if any of these commands is used. ONESTEP also executes the C command immediately after the DEFUSR line. Any type of variable can be used with the C command. This includes variables that use other variables, such as B$(X) or A(I,J). ONESTEP executes only one command each time ENTER is pressed. You must press ENTER several times to complete a multi-statement line.

How It Works

ONESTEP is a machine-language program written for a 32K Model I with disk and TRSDOS. When ONESTEP is first called, it ties itself to the front of the BASIC keyboard driver. Every time BASIC calls the keyboard (after each command), it calls ONESTEP instead. ONESTEP tests a set of flags and variables to see what needs to be done, does it, and jumps to the real keyboard driver.

In all but three cases this causes no problems. However, the INPUT, LINEINPUT and INKEY$ commands must scan the keyboard, which requires calling the keyboard driver and puts you back into ONESTEP. INPUT and LINEINPUT do a repetitive keyboard scan, so the program would never get past them. INKEY$ does a one-shot scan, so it always returns a null string. Patching sections of code—INSET into the INPUT routine, LINSET into the LINEINPUT routine, and INRES into the main interpreter—solves the problem with INPUT and LINEINPUT. No simple fix works for INKEY$.

One way around the INKEY$ problem is to temporarily replace the INKEY$ function with a LET statement, making the INKEY$ variable whatever you would have entered. Because ONESTEP uses QA$-QZ$ to store variable names, they must not be used in the target program. To change ONESTEP's variable names, change line 2020. To adjust the slow speed, change line 390.

ONESTEP commands are straightforward, but the display can be confusing. A PRINT@ command spreads ONESTEP output all over the screen. This is intentional. If lines were set aside for ONESTEP, program output could easily be overwritten. It is best to have ONESTEP output and program output on separate devices. Insert the following lines if you have a printer:

```
552   LD  HL,058DH
554   LD  (401EH),HL
1712  LD  HL,0458H
1714  LD  (401EH),HL
1742  LD  HL,0458H
1744  LD  (401EH),HL
```

The last problem involves monitoring array variables and is best illustrated by the following example:

```
10 DEFUSR 0=(&HBC00) : 0=USR 0(0) : DIM Y(50)
20 FOR X=0 TO 50
30 Y(X)=X
40 NEXT X
```

If ONESTEP is told to monitor Y(X), a subscript-out-of-range error occurs at line 40. In a FOR-NEXT loop the NEXT command increments the FOR variables and tests it against the TO argument. If the TO argument has been satisfied, program flow falls through the FOR-NEXT loop. However, the FOR variable is now greater than the TO argument (in the example X=51). At line 40 ONESTEP tries to print the variable Y(51), but Y is only dimensioned to 50; hence, the error.

ONESTEP is a good aid in teaching as well as in debugging. It is hard for people to catch the ins and outs of programming when one moment there's a program on the screen and the next the computer is printing answers. ONESTEP lets you see step-by-step what the computer is doing.

Program Listing

```
                   ;        ONESTEP BY AL SEHMER  08/31/81
                   ;
BC00                        ORG     0BC00H          ;BC00 = 48128
BC00 21B2BD                 LD      HL,INRES        ;ON RETURN FROM "INPUT"
BC03 22C541                 LD      (41C5H),HL      ;COMMAND PT. TO INRES
BC06 21A5BD                 LD      HL,LINSET       ;LOAD LINSET JUMP INTO
BC09 22A441                 LD      (41A4H),HL      ;"LINEINPUT" COMMAND
BC0C 3EC3                   LD      A,0C3H          ;LOAD INSET JUMP INTO
BC0E 32B857                 LD      (57B8H),A       ;"INPUT" COMMAND
BC11 2195BD                 LD      HL,INSET
BC14 22B957                 LD      (57B9H),HL
BC17 2171BE                 LD      HL,FLAG         ;INIT FLAG
BC1A 3630                   LD      (HL),30H        ;SINGLE STEP ON
BC1C 2123BC                 LD      HL,START        ;SET NEW DRIVER
BC1F 221640                 LD      (4016H),HL
BC22 C9                     RET                     ;RETURN FOR USR CALL
BC23 2171BE        START    LD      HL,FLAG         ;BASIC ENTRY POINT
BC26 CB7E                   BIT     7,(HL)          ;"INPUT" COMMAND ?
BC28 C2D843                 JP      NZ,43D8H        ;IF YES BACK TO BASIC
BC2B 2AA240                 LD      HL,(40A2H)
BC2E 222141                 LD      (4121H),HL      ;BASIC LINE # TO REG1
BC31 010A0A                 LD      BC,0A0AH
BC34 213A3C                 LD      HL,3C3AH        ;PT. TO SCREEN
BC37 CD2F13                 CALL    132FH           ;TO ASCII & DISPLAY
```

Program continued

```
BC3A 3E2Ø     ØØ34Ø          LD    A,2ØH
BC3C 323F3C   ØØ35Ø          LD    (3C3FH),A
BC3F 2171BE   ØØ36Ø          LD    HL,FLAG        ;TEST FOR NORM. OR SLOW
BC42 CB76     ØØ37Ø          BIT   6,(HL)
BC44 28Ø8     ØØ38Ø          JR    Z,TEST
BC46 21FF1F   ØØ39Ø          LD    HL,1FFFH
BC49 2B       ØØ4ØØ DELAY    DEC   HL
BC4A 7C       ØØ41Ø          LD    A,H
BC4B B5       ØØ42Ø          OR    L
BC4C 2ØFB     ØØ43Ø          JR    NZ,DELAY
BC4E 2171BE   ØØ44Ø TEST     LD    HL,FLAG
BC51 CB66     ØØ45Ø          BIT   4,(HL)         ;IS SINGLE SET FLAG SET
BC53 2Ø11     ØØ46Ø          JR    NZ,MAIN
BC55 3AØ438   ØØ47Ø          LD    A,(38Ø4H)      ;IS 'S' KEY PRESSED
BC58 218Ø38   ØØ48Ø          LD    HL,388ØH       ;PT. TO 'SHIFT' KEY
BC5B B6       ØØ49Ø          OR    (HL)
BC5C FEØ9     ØØ5ØØ          CP    9              ;ARE BOTH PRESSED
BC5E C2D843   ØØ51Ø          JP    NZ,43D8H       ;IF NOT BACK TO BASIC
BC61 2171BE   ØØ52Ø          LD    HL,FLAG
BC64 CBE6     ØØ53Ø          SET   4,(HL)         ;SET SINGLE STEP FLAG
BC66 21D843   ØØ54Ø MAIN     LD    HL,43D8H       ;RESTORE OLD DRIVER
BC69 22164Ø   ØØ55Ø          LD    (4Ø16H),HL
BC6C 3E41     ØØ56Ø          LD    A,41H          ;DO I NEED TO GET VARS.
BC6E 323BBE   ØØ57Ø          LD    (BUF1+1),A     ;BUF1 = QA$
BC71 213ABE   ØØ58Ø          LD    HL,BUF1        ;PT. TO BUF1
BC74 CDØD26   ØØ59Ø          CALL  26ØDH          ;WHERE IS QA$ STORED
BC77 1A       ØØ6ØØ          LD    A,(DE)         ;DE PTS. TO LENGTH OF QA$
BC78 A7       ØØ61Ø          AND   A              ;SET OR RESET ZERO FLAG
BC79 2Ø35     ØØ62Ø          JR    NZ,PRTLNE      ;NO NEED, SKIP GETVAR
BC7B 3A71BE   ØØ63Ø GETVAR   LD    A,(FLAG)
BC7E E6FØ     ØØ64Ø          AND   ØFØH           ;CLEAR VAR. COUNT
BC8Ø 3271BE   ØØ65Ø          LD    (FLAG),A
BC83 CDC9Ø1   ØØ66Ø          CALL  Ø1C9H          ;CLEAR SCREEN
BC86 21BFBD   ØØ67Ø          LD    HL,GETMSG      ;PT. TO MESSAGE
BC89 CD6F2Ø   ØØ68Ø          CALL  2Ø6FH          ;PRINT IT
BC8C 3A71BE   ØØ69Ø          LD    A,(FLAG)       ;GET VAR. COUNT
BC8F E6ØF     ØØ7ØØ NEXT     AND   ØFH            ;MASK OUT CONTROL BITS
BC91 C641     ØØ71Ø          ADD   A,41H          ;ADD OFFSET
BC93 323BBE   ØØ72Ø          LD    (BUF1+1),A     ;INSERT INTO BUFFER
BC96 213ABE   ØØ73Ø          LD    HL,BUF1        ;PT. TO INPUT BUFFER
BC99 CD9457   ØØ74Ø          CALL  5794H          ;INPUT VARIABLE
BC9C 213ABE   ØØ75Ø          LD    HL,BUF1        ;WAS INPUT A 'ENTER'
BC9F CDØD26   ØØ76Ø          CALL  26ØDH          ;WHERE IS ENTRY STORED
BCA2 1A       ØØ77Ø          LD    A,(DE)         ;DE PTS. TO ENTRY LENGTH
BCA3 A7       ØØ78Ø          AND   A              ;SET OR RESET ZERO FLAG
BCA4 CA2CBD   ØØ79Ø          JP    Z,PRTINS       ;IF ZERO DONE WITH INPUT
BCA7 3A71BE   ØØ8ØØ          LD    A,(FLAG)       ;GET VAR. COUNT
BCAA 3C       ØØ81Ø          INC   A
BCAB 3271BE   ØØ82Ø          LD    (FLAG),A       ;RESAVE COUNT
BCAE 18DF     ØØ83Ø          JR    NEXT           ;GET NEXT VARIABLE
BCBØ 21F6BD   ØØ84Ø PRTLNE   LD    HL,LNEMSG      ;PT. TO MESSAGE
BCB3 CD6F2Ø   ØØ85Ø          CALL  2Ø6FH          ;PRINT IT
BCB6 2AA24Ø   ØØ86Ø          LD    HL,(4ØA2H)     ;GET BASIC LINE NUMBER
BCB9 CDAFØF   ØØ87Ø          CALL  ØFAFH          ;TO ASCII & DISPLAY
BCBC 3A71BE   ØØ88Ø          LD    A,(FLAG)       ;GET VAR. COUNT
BCBF E6ØF     ØØ89Ø          AND   ØFH
BCC1 FEØØ     ØØ9ØØ          CP    Ø              ;IS COUNT EQUAL TO ZERO
BCC3 28B6     ØØ91Ø          JR    Z,GETVAR
BCC5 3EØØ     ØØ92Ø          LD    A,Ø            ;INIT # OF VARS. PRINTED
BCC7 327ØBE   ØØ93Ø          LD    (TEMP),A
BCCA 217ØBE   ØØ94Ø          LD    HL,TEMP
```

```
BCCD CD6F20   00950         CALL  206FH          ;START NEW LINE
BCD0 C641     00960 MORE    ADD   A,41H          ;ADD OFFSET
BCD2 323BBE   00970         LD    (BUF1+1),A     ;PUT IN BUF1
BCD5 213ABE   00980         LD    HL,BUF1        ;PT. TO BUF1
BCD8 CD0D26   00990         CALL  260DH          ;WHERE IS VAR. STORED
BCDB ED536EBE 01000         LD    (BUF3),DE      ;STORE ADDRESS IN BUF3
BCDF 213EBE   01010         LD    HL,BUF2        ;PT. TO STRING FOR PRINT
BCE2 3622     01020         LD    (HL),22H       ;ADD " TO BUF2
BCE4 23       01030         INC   HL
BCE5 EB       01040         EX    DE,HL
BCE6 010000   01050         LD    BC,0           ;CLEAR BC FOR LDIR
BCE9 DD2A6EBE 01060         LD    IX,(BUF3)      ;PT. TO VAR. NAME LENGTH
BCED DD4E00   01070         LD    C,(IX+0)       ;C=LENGTH OF NAME
BCF0 DD6E01   01080         LD    L,(IX+1)
BCF3 DD6602   01090         LD    H,(IX+2)       ;HL=LOC. OF VARIABLE NAME
BCF6 EDB0     01100         LDIR                 ;MOVE VAR. NAME TO BUF2
BCF8 EB       01110         EX    DE,HL
BCF9 363D     01120         LD    (HL),3DH       ;ADD = TO BUF2
BCFB 23       01130         INC   HL
BCFC 3622     01140         LD    (HL),22H       ;ADD " TO BUF2
BCFE 23       01150         INC   HL
BCFF 363B     01160         LD    (HL),3BH       ;ADD ; TO BUF2
BD01 23       01170         INC   HL
BD02 EB       01180         EX    DE,HL
BD03 010000   01190         LD    BC,0
BD06 DD4E00   01200         LD    C,(IX+0)
BD09 DD6E01   01210         LD    L,(IX+1)       ;SAME FUNCTION AS ABOVE
BD0C DD6602   01220         LD    H,(IX+2)
BD0F EDB0     01230         LDIR
BD11 EB       01240         EX    DE,HL
BD12 362C     01250         LD    (HL),2CH       ;ADD , TO BUF2
BD14 23       01260         INC   HL
BD15 3600     01270         LD    (HL),0         ;ADD TERMINATOR
BD17 213EBE   01280         LD    HL,BUF2        ;PT. TO OUTPUT BUFFER
BD1A CD6F20   01290         CALL  206FH          ;PRINT IT
BD1D 3A71BE   01300         LD    A,(FLAG)       ;GET VAR. COUNT
BD20 E60F     01310         AND   0FH            ;MASK OUT CONTROL BITS
BD22 2170BE   01320         LD    HL,TEMP        ;PT. TO TEMP
BD25 34       01330         INC   (HL)
BD26 BE       01340         CP    (HL)           ;AM I DONE ?
BD27 3A70BE   01350         LD    A,(TEMP)
BD2A 20A4     01360         JR    NZ,MORE
BD2C 3E00     01370 PRTINS  LD    A,0
BD2E 3270BE   01380         LD    (TEMP),A
BD31 2170BE   01390         LD    HL,TEMP
BD34 CD6F20   01400         CALL  206FH          ;START NEW LINE
BD37 210CBE   01410         LD    HL,INSMSG      ;PT. TO MESSAGE
BD3A CD6F20   01420         CALL  206FH          ;PRINT IT
BD3D CD4900   01430 GETKEY  CALL  0049H          ;SCAN KEYBOARD
BD40 FE4E     01440         CP    4EH            ;IS IT 'N'
BD42 2009     01450         JR    NZ,SKEY
BD44 2171BE   01460         LD    HL,FLAG        ;PT. TO FLAG
BD47 CBA6     01470         RES   4,(HL)         ;CLEAR SINGLE STEP FLAG
BD49 CBB6     01480         RES   6,(HL)         ;CLEAR SLOW FLAG
BD4B 183F     01490         JR    DONE           ;RETURN TO BASIC
BD4D FE53     01500 SKEY    CP    53H            ;IS IT 'S'
BD4F 2009     01510         JR    NZ,CKEY
BD51 2171BE   01520         LD    HL,FLAG
BD54 CBA6     01530         RES   4,(HL)         ;CLEAR SINGLE STEP FLAG
BD56 CBF6     01540         SET   6,(HL)         ;SET SLOW FLAG
BD58 1832     01550         JR    DONE
```

Program continued

```
BD5A FE43     01560 CKEY   CP     43H           ;IS IT 'C'
BD5C CA7BBC   01570        JP     Z,GETVAR
BD5F FE0D     01580        CP     0DH           ;IS IT 'ENTER'
BD61 2829     01590        JR     Z,DONE
BD63 FE4B     01600        CP     4BH           ;IS IT 'K'
BD65 20D6     01610        JR     NZ,GETKEY
BD67 21D843   01620        LD     HL,43D8H      ;RESTORE OLD DRIVER
BD6A 221640   01630        LD     (4016H),HL
BD6D 218657   01640        LD     HL,5786H      ;REMOVE LINSET JUMP FROM
BD70 22A441   01650        LD     (41A4H),HL    ;THE "LINEINPUT" COMMAND
BD73 DD21B857 01660        LD     IX,57B8H      ;REMOVE INSET JUMP FROM
BD77 DD3600E5 01670        LD     (IX+0),0E5H   ;THE "INPUT" COMMAND
BD7B DD3601FE 01680        LD     (IX+1),0FEH
BD7F DD360223 01690        LD     (IX+2),23H
BD83 21305A   01700        LD     HL,5A30H      ;REMOVE INRES JUMP
BD86 22C541   01710        LD     (41C5H),HL
BD89 C3D843   01720        JP     43D8H         ;BACK TO BASIC
BD8C 2123BC   01730 DONE   LD     HL,START      ;SET NEW DRIVER
BD8F 221640   01740        LD     (4016H),HL
BD92 C3D843   01750        JP     43D8H         ;BACK TO BASIC
BD95 F5       01760 INSET  PUSH   AF            ;SAVE REGS.
BD96 3A71BE   01770        LD     A,(FLAG)
BD99 F680     01780        OR     80H           ;SET "INPUT" CALLED FROM
BD9B 3271BE   01790        LD     (FLAG),A      ;TARGET PROGRAM FLAG
BD9E F1       01800        POP    AF            ;RESTORE REGS.
BD9F E5       01810        PUSH   HL
BDA0 FE23     01820        CP     23H
BDA2 C3BB57   01830        JP     57BBH         ;JP TO DOS EXIT
BDA5 F5       01840 LINSET PUSH   AF            ;SAVE REGS.
BDA6 3A71BE   01850        LD     A,(FLAG)      ;SET "LINEINPUT" FLAG
BDA9 F680     01860        OR     80H
BDAB 3271BE   01870        LD     (FLAG),A
BDAE F1       01880        POP    AF            ;RESTORE REGS.
BDAF C38657   01890        JP     5786H         ;JP. TO DOS EXIT
BDB2 F5       01900 INRES  PUSH   AF            ;SAVE REGS.
BDB3 3A71BE   01910        LD     A,(FLAG)      ;RESET "INPUT" BIT IN
BDB6 E67F     01920        AND    7FH           ;FLAG REG.  (BIT 7)
BDB8 3271BE   01930        LD     (FLAG),A
BDBB F1       01940        POP    AF            ;RESTORE REGS.
BDBC C3305A   01950        JP     5A30H         ;JP TO DOS EXIT
BDBF 22       01960 GETMSG DEFM   '"ENTER VARIABLES TO MONITOR, PRESS ENTER TO END INPUT"'
BDF5 00       01970        DEFB   00
BDF6 22       01980 LNEMSG DEFM   '"WORKING ON LINE # ";'
BE0B 00       01990        DEFB   00
BE0C 22       02000 INSMSG DEFM   '"<N>ORMAL  <S>LOW  <C>HANGE  <ENTER>  <K>ILL"'
BE39 00       02010        DEFB   00
BE3A 51       02020 BUF1   DEFM   'Q $'
BE3D 00       02030        DEFB   00
0030          02040 BUF2   DEFS   30H
BE6E 0000     02050 BUF3   DEFW   0000
BE70 00       02060 TEMP   DEFB   00
BE71 00       02070 FLAG   DEFB   00
0000          02080        END
00000 TOTAL ERRORS
```

20

Renumber Your BASIC Program

by Gary L. Simonds

System Requirements:
Model I or III
16K RAM
Level II BASIC

Have you ever had to retype part of your BASIC program because you didn't leave enough room between line numbers to make corrections? This renumber utility program is the answer. It also adds a professional look to your programs.

The renumber program lets you renumber a previously written BASIC program. You may specify any starting line (0–65535) and the increment between program lines (1–32767). The renumber program also searches your program for a reference to an existing line number and adjusts that reference accordingly. In Figure 1, the number 17 after the THEN command in line 10 is a reference to line 17.

For an example of the actual operations performed by the renumber program, see Figures 1 and 2. Figure 1 represents an ordinary BASIC program. Figure 2 shows the same program renumbered with a starting line number of 10 and an increment of 5. Not only are the lines renumbered, but the references to line numbers within a program line have also been updated to reflect the correct line numbers.

The renumber program is written in assembly language. The BASIC program in Program Listing 1 POKEs the machine-language code for the renumber program into memory. The actual renumber program is contained in the data statements of Program Listing 1. Program Listing 2 contains the assembly code for the renumber program, for those who prefer to enter the renumber program using an editor/assembler.

```
  5 CLS
 10 IF X=3 THEN 17 ELSE X=X+1
 11 GOTO 25
 17 X=1
 25 ON X GOTO 50,51,100
 50 PRINT "X=1" : GOTO 10
 51 PRINT "X=2" : GOTO 10
100 PRINT "X=3": GOTO 10
```

Figure 1. *A typical BASIC program*

The BASIC Program

Here is how to use Program Listing 1.

- Set the memory size to 31999. The renumber program occupies the memory addresses from 32000 to 32698. Setting the memory size prevents BASIC from using memory that contains the renumber program.
- Load Program Listing 1 and run it. If you have made any mistakes in typing, the program stops and prompts you to check for errors. A checksum is performed on the data statements. If the resulting checksum is not as expected, an error is indicated and you must revise the data statements to match the listing.
- Type NEW and load the program you wish to renumber. Do not run it.
- Enter the SYSTEM mode by typing SYSTEM, and press ENTER. The *? system prompt should appear.
- Type /32093 and press ENTER. This tells the computer to start execution of the machine-language program starting at memory location 32093. The renumber program is now in control. The screen should display the title of the renumber program and the statement ENTER STARTING LINE NUMBER.
- Enter the starting line number desired (0–65535), and press ENTER.
- Enter the increment desired between lines (1–32767).

The renumber program now renumbers your program, then returns to BASIC so you can list or save your program.

```
10 CLS
15 IF X=3 THEN 25 ELSE X=X+1
20 GOTO 30
25 X=1
30 ON X GOTO 35,40,45
35 PRINT "X=1" : GOTO 15
40 PRINT "X=2" : GOTO 15
45 PRINT "X=3" : GOTO 15
```

Figure 2. *The program in Figure 1 renumbered with a starting line number of 10 and an increment between lines of 5*

The Assembly-Language Program

To use the assembly-language program, set the memory size to 31999. Load Program Listing 2. You must load the program in the SYSTEM mode since it is a machine-language program. Do not run it. Return to BASIC, and continue from the third instruction for Program Listing 1 (type NEW, etc.)

Limitations and Bugs

The renumber program only changes references to other line numbers if the reference is preceded by a few special command tokens, including GOTO, GOSUB, ON-GOTO, THEN, ON-GOSUB, and ELSE. If the reference is not preceded by one of these tokens, it is not recognized by the renumber program as a reference.

The program to be renumbered should not contain lines with packed machine language. The renumber program can't tell whether the starting line number and the increment will overshoot the maximum line number of 65535. Be careful to choose a starting line number and increment that will not generate line numbers greater than 65535.

A bug shows up the first time you try to save the program that has just been renumbered. An OM (out of memory) error appears. The second time you try to save the program, it works without error. Almost all commands, except the LIST command, cause an OM error if they are the first command executed after the renumber program has been used. Since CSAVE turns on the tape recorder and wastes tape before the OM error occurs, I usually execute a CLEAR command first. The CLEAR command causes the OM error and doesn't waste any tape or damage the program.

The renumber program occupies the memory space 32000 to 32698, which is a little less than 1000 bytes of code, or 1K. The actual starting address of the program is 32093. There is approximately 15K of memory left for the BASIC program that is to be renumbered. The program execution time varies with the size of the BASIC program to be renumbered and the number of references in it.

How It Works

To understand how the renumber program works, you must understand that each BASIC program line contains a pointer to the next program line, its own line number, the instructions themselves, and an end-of-line indicator (00).

Each BASIC command is stored in memory as a token, not as ASCII characters. For instance, a token of 141 represents a GOTO statement. This saves memory space and makes decoding of the instructions easier. The renumber program searches for the tokens shown in Figure 3.

Command	Token
GOTO	141
GOSUB	145
THEN	202
ELSE	149
ON. . . GOTO,ON. . . GOSUB	161

Figure 3. *BASIC commands and their tokens*

When a token is found, the number following it is a reference. The new reference is then calculated and inserted.

Replacing a reference raises a few possible problems. If the new reference number has more digits than the old reference number, room must be made to accommodate the extra digits. This is done by shifting the remainder of the program higher in memory by the appropriate number of digits. You must also go back and update the pointer of each program line to the following program line. If there are fewer characters in the new reference number, you compress the remaining program lines by the appropriate number of digits. When all the references have been updated, you must update each program line number.

Program Listing 1

```
0 REM RENUMBER (USING BASIC TO POKE IT IN MEMORY)
                           BY GARY L. SIMONDS
1 REM LINE 10 SETS UP VARIABLES
2 REM LINE 20 READS DATA, ADDS CHECKSUM, POKES DATA INTO MEMORY
3 REM LINES 40 TO 100 CHECK CHECKSUM FOR ERRORS
4 REM LINES 120-520 DATA STATEMENTS
5 REM LINE 530 PRINTS OUT ERROR IF ANY EXIST
10 CLS:DEFINT A,B,C,E,I:DEFSNG S
20 FORI=32000 TO 32698: READ A :S=S+A: POKE I,A
30 C=S
40 IF I=32098 THEN S=0:IF C<>6826 THEN B=120:E=160:GOSUB 530
50 IF I=32198 THEN S=0:IF C<>11181 THEN B=170:E=220:GOSUB 530
60 IF I=32299 THEN S=0:IF C<>11860 THEN B=230:E=280:GOSUB 530
70 IF I=32400 THEN S=0:IF C<>12012 THEN B=290:E=340:GOSUB 530
80 IF I=32499 THEN S=0:IF C<>11861 THEN B=350:E=400:GOSUB 530
90 IF I=32597 THEN S=0:IF C<>12235 THEN B=410:E=460:GOSUB 530
100 IF I=32698 THEN S=0:IF C<>8876 THEN B=470:E=520:GOSUB 530
110 NEXT I:END
120 DATA 82,69,78,85,77,66,69,82,32,66,89,32,71,65,82,89,32,76,4
6,32
130 DATA 83,73,77,79,78,68,83,13,54,45,50,53,45,56,49,32,82,69,8
6,73
140 DATA 83,73,79,78,32,48,46,48,13,69,78,84,69,82,32,83,84,65,8
2,84
150 DATA 73,78,71,32,76,73,78,69,32,78,85,77,66,69,82,13,69,78,8
4,69
160 DATA 82,32,73,78,67,82,69,77,69,78,84,13,225,205,201,1,33,0,
125
```

```
170 DATA 205,212,125,33,28,125,205,212,125,62,13,205,51,0,33,49,
125
180 DATA 205,166,125,34,153,127,33,76,125,205,166,125,125,180,32
,2
190 DATA 46,1,34,155,127,124,254,128,48,207,42,164,64,34,157,127
,205
200 DATA 228,125,205,109,127,42,249,64,34,251,64,34,253,64,195,2
5
210 DATA 26,205,212,125,6,5,33,177,127,205,64,0,33,176,127,215,4
8
220 DATA 165,33,177,127,205,108,14,58,175,64,254,2,40,12,254,4,3
2
230 DATA 148,58,36,65,205,251,10,235,201,42,33,65,201,126,35,254
,13
240 DATA 202,224,125,205,51,0,24,244,205,51,0,201,34,185,127,94,
35
250 DATA 86,35,237,83,161,127,94,35,86,237,83,163,127,35,126,167
,40
260 DATA 22,254,141,40,39,254,145,40,35,254,149,40,31,254,202,40
,27
270 DATA 254,161,40,42,24,229,35,126,167,32,7,35,126,167,32,1,20
1
280 DATA 43,237,91,161,127,223,32,211,24,190,215,40,232,48,204,2
29
290 DATA 205,90,30,225,237,83,165,127,205,94,126,24,190,215,40,2
13
300 DATA 254,141,40,4,254,145,32,245,215,40,202,48,14,229,205,90
,30
310 DATA 225,237,83,165,127,205,94,126,24,237,254,44,194,247,125
,24
320 DATA 230,34,159,127,1,0,0,42,157,127,94,35,86,213,123,178,20
2
330 DATA 63,127,35,94,35,86,42,165,127,223,40,4,225,3,24,233,209
,17
340 DATA 0,0,121,176,40,4,42,155,127,235,42,153,127,25,121,176,4
0
350 DATA 5,11,121,176,32,246,34,169,127,34,33,65,33,171,127,1,7,
7
360 DATA 205,47,19,42,159,127,205,68,127,121,50,167,127,205,76,1
27
370 DATA 121,50,168,127,58,167,127,145,40,51,242,12,127,245,167,
42
380 DATA 249,64,229,237,75,159,127,237,66,229,193,225,229,209,19
,237
390 DATA 184,42,249,64,35,34,249,64,42,161,127,35,34,161,127,235
,42
400 DATA 185,127,115,35,114,205,252,26,241,60,32,208,58,168,127,
79
410 DATA 6,0,33,171,127,237,91,159,127,237,176,58,168,127,42,159
,127
420 DATA 133,111,62,0,140,103,201,245,167,42,249,64,237,75,159,1
27
430 DATA 237,66,229,193,42,159,127,229,209,35,237,176,42,249,64,
43
440 DATA 34,249,64,42,161,127,43,34,161,127,235,42,185,127,115,3
5
450 DATA 114,205,252,26,241,61,32,207,24,177,209,42,159,127,201,
14
460 DATA 0,43,215,208,12,24,251,14,0,33,171,127,43,215,208,254,4
8
470 DATA 40,5,12,215,208,24,251,229,197,213,1,5,0,229,209,35,237
,176
```

Program continued

```
480 DATA 209,193,225,24,228,42,155,127,235,42,153,127,167,237,82
,34
490 DATA 183,127,42,157,127,94,35,86,123,178,200,213,35,229,42,1
55
500 DATA 127,235,42,183,127,25,34,183,127,235,225,115,35,114,225
,24
510 DATA 228,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0
520 DATA 0,0,0,0,0,0,0
530 PRINT"CHECK DATA LINES ";B;" TO ";E;". THERE IS AN ERROR.":R
ETURN
```

Program Listing 2

```
7D00             00010            ORG     7D00H
7D00 52          00020 TEXT1      DEFM    'RENUMBER BY GARY L. SIMONDS'
7D1B 0D          00030            DEFB    0DH
7D1C 36          00040 TEXT2      DEFM    '6-25-81 REVISION 0.0'
7D30 0D          00050            DEFB    0DH
7D31 45          00060 TEXT3      DEFM    'ENTER STARTING LINE NUMBER'
7D4B 0D          00070            DEFB    0DH
7D4C 45          00080 TEXT4      DEFM    'ENTER INCREMENT'
7D5B 0D          00090            DEFB    0DH
7D5C E1          00100 BEGIN1     POP     HL        ;DUMMY POP
                 00110 ;*****************************************
                 00120 ;*            BEGIN
                 00130 ;*  BEGIN IS THE START OF THE RENUMBER
                 00140 ;*  ROUTINE.
                 00150 ;*  1. PROMPTS FOR PROPER INPUTS
                 00160 ;*  2. RENUMBERS REFERENCES
                 00170 ;*  3. RENUMBERS LINES
                 00180 ;*  4. RETURNS TO BASIC
                 00190 ;*  INTERNAL CALLS-DISPLY,INPKB,NEWLIN,UPDATE
                 00200 ;*  EXTERNAL CALLS-01C9-CLEARS SCREEN,1A19-
                 00210 ;*  RETURNS TO BASIC,0033-DISPLAYS CHARACTER
                 00220 ;*****************************************
7D5D CDC901      00230 BEGIN      CALL    01C9H     ;CLEAR THE SCREEN
7D60 21007D      00240            LD      HL,TEXT1
7D63 CDD47D      00250            CALL    DISPLY  ;DISPLAY TITLE & DATE
7D66 211C7D      00260            LD      HL,TEXT2
7D69 CDD47D      00270            CALL    DISPLY
7D6C 3E0D        00280            LD      A,0DH
7D6E CD3300      00290            CALL    0033H
7D71 21317D      00300            LD      HL,TEXT3     ;PROMPT FOR STARTING LINE #
7D74 CDA67D      00310            CALL    INPKB
7D77 22997F      00320            LD      (START),HL      ;SAVE IT IN 'START'
7D7A 214C7D      00330            LD      HL,TEXT4
7D7D CDA67D      00340            CALL    INPKB   ;PROMPT FOR INCREMENT
7D80 7D          00350            LD      A,L
7D81 B4          00360            OR      H
7D82 2002        00370            JR      NZ,NOT0   ;IF INCREMENT=0, FORCE IT TO 1
7D84 2E01        00380            LD      L,01
7D86 229B7F      00390 NOT0       LD      (INCR),HL       ;SAVE IT IN 'INCR'
7D89 7C          00400            LD      A,H
7D8A FE80        00410            CP      80H
7D8C 30CF        00420            JR      NC,BEGIN ;IF INCR IS NOT NUMERIC, START OVER
7D8E 2AA440      00430            LD      HL,(40A4H)
7D91 229D7F      00440            LD      (STRBSC),HL     ;GET STARTING ADDR. OF BASIC
```

```
7D94 CDE47D   ØØ45Ø          CALL   NEWLN   ;SEARCH AND CORRECT REFERENCES
7D97 CD6D7F   ØØ46Ø          CALL   UPDATE  ;UPDATE ALL LINE #S
7D9A 2AF94Ø   ØØ47Ø          LD     HL,(4ØF9H)
7D9D 22FB4Ø   ØØ48Ø          LD     (4ØFBH),HL  ;RESTORE, STACK & END OF BASIC
7DAØ 22FD4Ø   ØØ49Ø          LD     (4ØFDH),HL
7DA3 C3191A   ØØ5ØØ          JP     1A19H   ;RETURN TO BASIC
              ØØ51Ø ;****************************************************
              ØØ52Ø ;*              INPKB
              ØØ53Ø ;*  1.DISPLAY MESSAGE TEXT
              ØØ54Ø ;*  2.INPUT UP TO 5 ASCII CHARACTERS
              ØØ55Ø ;*  3.CONVERT THE NUMBER TO BINARY
              ØØ56Ø ;*  4.RETURN # IN HL-REG PAIR
              ØØ57Ø ;*   INTERNAL CALLS-DISPLY
              ØØ58Ø ;*   EXTERNAL CALLS-ØE6C-CONVERTS ASCII TO BINARY
              ØØ59Ø ;*   ØAFB-CONVERTS SINGLE PRECISION TO INTEGER
              ØØ6ØØ ;*   ØØ4Ø-INPUT FROM KEYBOARD
              ØØ61Ø ;****************************************************
7DA6 CDD47D   ØØ62Ø INPKB    CALL   DISPLY  ;DISPLAY TEXT
7DA9 Ø6Ø5     ØØ63Ø          LD     B,Ø5    ;INPUT 5 ASCII CHARACTERS
7DAB 21B17F   ØØ64Ø          LD     HL,KBUFF
7DAE CD4ØØØ   ØØ65Ø          CALL   ØØ4ØH
7DB1 21BØ7F   ØØ66Ø          LD     HL,KBUFF-1
7DB4 D7       ØØ67Ø          RST    1ØH     ;TEST INPUT
7DB5 3ØA5     ØØ68Ø          JR     NC,BEGIN1
7DB7 21B17F   ØØ69Ø          LD     HL,KBUFF
7DBA CD6CØE   ØØ7ØØ          CALL   ØE6CH   ;CONVERT IT TO BINARY
7DBD 3AAF4Ø   ØØ71Ø          LD     A,(4ØAFH)
7DCØ FEØ2     ØØ72Ø          CP     2       ;TEST FOR INTEGER
7DC2 28ØC     ØØ73Ø          JR     Z,INPK1   ;JUMP IF IT IS
7DC4 FEØ4     ØØ74Ø          CP     4       ;TEST FOR SINGLE PRECISION
7DC6 2Ø94     ØØ75Ø          JR     NZ,BEGIN1       ;START OVER IF NOT
7DC8 3A2441   ØØ76Ø          LD     A,(4124H)
7DCB CDFBØA   ØØ77Ø          CALL   ØAFBH   ;CONVERT TO INTEGER
7DCE EB       ØØ78Ø          EX     DE,HL
7DCF C9       ØØ79Ø          RET
7DDØ 2A2141   ØØ8ØØ INPK1    LD     HL,(4121H)      ;RETURN WITH #IN HL
7DD3 C9       ØØ81Ø          RET
              ØØ82Ø ;**********************************************
              ØØ83Ø ;*              DISPLY
              ØØ84Ø ;*  1. SEND MESSAGE TEXT TO DISPLAY
              ØØ85Ø ;*  2. STOP WHEN RETURN IS ENCOUNTERED
              ØØ86Ø ;*  EXTERNAL CALLS-ØØ33-DISPLAY A CHARACTER
              ØØ87Ø ;*  ON THE SCREEN
              ØØ88Ø ;**********************************************
7DD4 7E       ØØ89Ø DISPLY   LD     A,(HL)
7DD5 23       ØØ9ØØ          INC    HL
7DD6 FEØD     ØØ91Ø          CP     ØDH     ;NEXT CHARACTER A RET?
7DD8 CAEØ7D   ØØ92Ø          JP     Z,DISPL1        ;JUMP IF IT IS
7DDB CD33ØØ   ØØ93Ø          CALL   ØØ33H   ;DISPLAY CHARACTER
7DDE 18F4     ØØ94Ø          JR     DISPLY
7DEØ CD33ØØ   ØØ95Ø DISPL1   CALL   ØØ33H   ;SEND RETURN AND RETURN
7DE3 C9       ØØ96Ø          RET
              ØØ97Ø ;****************************************
              ØØ98Ø ;*              NEWLN
              ØØ99Ø ;*  1. CHECK LINE FOR REFERENCE
              Ø1ØØØ ;*  2. CALCULATE NEW REFERENCE
              Ø1Ø1Ø ;*  3. INSERT NEW REFERENCE
              Ø1Ø2Ø ;*  4. CONTINUE UNTIL ALL LINES CHECKED
              Ø1Ø3Ø :*  INTERNAL CALLS-SUBTT
              Ø1Ø4Ø ;*  EXTERNAL CALLS-1E5A-CONVERTS ASCII TO BINARY
              Ø1Ø5Ø ;****************************************
```

Program continued

```
7DE4 22B97F   01060 NEWLN   LD    (LNSTRT),HL      ;SAVE ADDR. OF LINE
7DE7 5E       01070         LD    E,(HL)
7DE8 23       01080         INC   HL
7DE9 56       01090         LD    D,(HL)
7DEA 23       01100         INC   HL
7DEB ED53A17F 01110         LD    (NXTLN),DE       ;SAVE POINTER TO NEXT LINE
7DEF 5E       01120         LD    E,(HL)
7DF0 23       01130         INC   HL
7DF1 56       01140         LD    D,(HL)
7DF2 ED53A37F 01150         LD    (LNNUM),DE       ;SAVE LINE #
7DF6 23       01160 GETCHR  INC   HL     ;POINT TO NEXT CHARACTER
7DF7 7E       01170 GETCH1  LD    A,(HL)
7DF8 A7       01180         AND   A
7DF9 2816     01190         JR    Z,ENDTST         ;TEST FOR END OF LINE
7DFB FE8D     01200         CP    141
7DFD 2827     01210         JR    Z,GBNCH      ;TEST FOR 'GOTO'
7DFF FE91     01220         CP    145
7E01 2823     01230         JR    Z,GBNCH    ;TEST FOR 'GOSUB'
7E03 FE95     01240         CP    149
7E05 281F     01250         JR    Z,GBNCH    ;TEST FOR 'ELSE'
7E07 FECA     01260         CP    202
7E09 281B     01270         JR    Z,GBNCH    ;TEST FOR 'THEN'
7E0B FEA1     01280         CP    161
7E0D 282A     01290         JR    Z,ONBCH    ;TEST FOR 'ON'
7E0F 18E5     01300         JR    GETCHR
7E11 23       01310 ENDTST  INC   HL
7E12 7E       01320         LD    A,(HL)   ;TEST NEXT CHARACTER FOR ZERO
7E13 A7       01330         AND   A
7E14 2007     01340         JR    NZ,NTLN1         ;JUMP IF NOT ZERO
7E16 23       01350         INC   HL
7E17 7E       01360         LD    A,(HL)   ;TEST FOR SECOND ZERO
7E18 A7       01370         AND   A
7E19 2001     01380         JR    NZ,NTLNE         ;JUMP IF NOT ZERO
7E1B C9       01390         RET
7E1C 2B       01400 NTLNE   DEC   HL
7E1D ED5BA17F 01410 NTLN1   LD    DE,(NXTLN)       ;ADDR. = NEXT LINE ADDR.
7E21 DF       01420         RST   18H
7E22 20D3     01430         JR    NZ,GETCH1    ;IF NOT, GO TEST NEXT CHARACTER
7E24 18BE     01440         JR    NEWLN   ;IF YES, GET NEW LINE
7E26 D7       01450 GBNCH   RST   10H
7E27 28E8     01460         JR    Z,ENDTST         ;TEST FOR END OF LINE
7E29 30CC     01470         JR    NC,GETCH1        ;JUMP IF NOT NUMERIC
7E2B E5       01480         PUSH  HL     ;FOUND REFERENCE
7E2C CD5A1E   01490         CALL  1E5AH  ;CONVERT TO BINARY
7E2F E1       01500         POP   HL
7E30 ED53A57F 01510         LD    (LNREF),DE       ;SAVE LINE IN LNREF
7E34 CD5E7E   01520         CALL  SUBTT  ;GO SUBSTITUTE NEW REFERENCE
7E37 18BE     01530         JR    GETCH1 ;GET NEXT CHARACTER
7E39 D7       01540 ONBCH   RST   10H    ;FOUND 'ON' REFERENCE
7E3A 28D5     01550         JR    Z,ENDTST
7E3C FE8D     01560         CP    141    ;TEST FOR GOTO
7E3E 2804     01570         JR    Z,ONBC1
7E40 FE91     01580         CP    145    ;TEST FOR GOSUB
7E42 20F5     01590         JR    NZ,ONBCH
7E44 D7       01600 ONBC1   RST   10H
7E45 28CA     01610         JR    Z,ENDTST         ;TEST FOR END OF LINE
7E47 300E     01620         JR    NC,ONBC2         ;JUMP IF NOT NUMERIC
7E49 E5       01630         PUSH  HL
7E4A CD5A1E   01640         CALL  1E5AH  ;CONVERT TO BINARY
7E4D E1       01650         POP   HL
7E4E ED53A57F 01660         LD    (LNREF),DE       ;SAVE LINE IN LNREF
```

```
7E52 CD5E7E    Ø167Ø          CALL   SUBTT   ;SUBSTITUTE NEW REFERENCE
7E55 18ED      Ø168Ø          JR     ONBC1
7E57 FE2C      Ø169Ø ONBC2    CP     2CH     ;TEST FOR COMMA
7E59 C2F77D    Ø17ØØ          JP     NZ,GETCH1       ;IF NOT GET NEXT CHARACTER
7E5C 18E6      Ø171Ø          JR     ONBC1   ;OTHERWISE, CONTINUE
               Ø172Ø ;******************************************
               Ø173Ø ;*              SUBTT
               Ø174Ø ;*  1. SEARCH FOR LINE THAT IS REFERENCED
               Ø175Ø ;*  2. CALCULATE THE NEW LINE #
               Ø176Ø ;*  3. SUBSTITUTE NEW REFERENCE INTO LINE
               Ø177Ø ;*  INTERNAL CALLS-NCHK,FIXCHR
               Ø178Ø ;*  EXTERNAL CALLS-132F-CONVERT BINARY TO ASCII
               Ø179Ø ;*  1AFC-CALCULATE NEW LINE ADDRESSES
               Ø18ØØ ;******************************************
7E5E 229F7F    Ø181Ø SUBTT    LD     (PRSPS),HL      ;SAVE THE PRESENT POSITION
7E61 Ø1ØØØØ    Ø182Ø          LD     BC,ØØØØ
7E64 2A9D7F    Ø183Ø          LD     HL,(STRBSC)
7E67 5E        Ø184Ø SUBT1    LD     E,(HL)
7E68 23        Ø185Ø          INC    HL
7E69 56        Ø186Ø          LD     D,(HL)
7E6A D5        Ø187Ø          PUSH   DE      ;DE = ADDR. OF NEXT LINE
7E6B 7B        Ø188Ø          LD     A,E
7E6C B2        Ø189Ø          OR     D
7E6D CA3F7F    Ø19ØØ          JP     Z,SUEXT    ;IF DE = ZERO, WE ARE DONE
7E7Ø 23        Ø191Ø          INC    HL
7E71 5E        Ø192Ø          LD     E,(HL)
7E72 23        Ø193Ø          INC    HL
7E73 56        Ø194Ø          LD     D,(HL)     ;DE = LINE #
7E74 2AA57F    Ø195Ø          LD     HL,(LNREF)      ;HL = LINE WE ARE WORKING ON
7E77 DF        Ø196Ø          RST    18H
7E78 28Ø4      Ø197Ø          JR     Z,SUBT2    ;JUMP IF THEY ARE EQUAL
7E7A E1        Ø198Ø          POP    HL
7E7B Ø3        Ø199Ø          INC    BC      ;ELSE GO TO NEXT LINE AND
7E7C 18E9      Ø2ØØØ          JR     SUBT1   ;INCREMENT BC
7E7E D1        Ø2Ø1Ø SUBT2    POP    DE
7E7F 11ØØØØ    Ø2Ø2Ø          LD     DE,ØØØØ
7E82 79        Ø2Ø3Ø          LD     A,C     ;CALCULATE NEW REFERENCE
7E83 BØ        Ø2Ø4Ø          OR     B
7E84 28Ø4      Ø2Ø5Ø          JR     Z,SUBT3
7E86 2A9B7F    Ø2Ø6Ø          LD     HL,(INCR)  ;NEW REF=BC*(INCR)+START
7E89 EB        Ø2Ø7Ø          EX     DE,HL
7E8A 2A997F    Ø2Ø8Ø SUBT3    LD     HL,(START)
7E8D 19        Ø2Ø9Ø SUBT4    ADD    HL,DE
7E8E 79        Ø21ØØ          LD     A,C
7E8F BØ        Ø211Ø          OR     B
7E9Ø 28Ø5      Ø212Ø          JR     Z,SUBT5
7E92 ØB        Ø213Ø          DEC    BC
7E93 79        Ø214Ø          LD     A,C
7E94 BØ        Ø215Ø          OR     B
7E95 2ØF6      Ø216Ø          JR     NZ,SUBT4
7E97 22A97F    Ø217Ø SUBT5    LD     (NWLNM),HL  ;SAVE NEW REFERENCE IN NWLNM
7E9A 222141    Ø218Ø          LD     (4121H),HL
7E9D 21AB7F    Ø219Ø          LD     HL,BUFF
7EAØ Ø1Ø7Ø7    Ø22ØØ          LD     BC,Ø7Ø7H     ;CONVERT NEW REF TO ASCII
7EA3 CD2F13    Ø221Ø          CALL   132FH
7EA6 2A9F7F    Ø222Ø          LD     HL,(PRSPS)
7EA9 CD447F    Ø223Ø          CALL   NCHK     ;CALCULATE # OF DIGITS IN OLD REF
7EAC 79        Ø224Ø          LD     A,C
7EAD 32A77F    Ø225Ø          LD     (CHRNO),A    ;CHRNO=# OF DIGITS IN OLD REF
7EBØ CD4C7F    Ø226Ø          CALL   FIXCHR    ;FIX # TO PROPER FORMAT
7EB3 79        Ø227Ø          LD     A,C
```

Program continued

```
7EB4 32A87F    02280          LD     (CHRNN),A     ;CHRNN=# DIGITS IN NEW REF
7EB7 3AA77F    02290          LD     A,(CHRNO)
7EBA 91        02300          SUB    C
7EBB 2833      02310          JR     Z,SUBT8      ;JUMP IF CHRNO=CHRNN
7EBD F20C7F    02320          JP     P,SUBT7      ;JUMP IF CHRNO > CHRNN
7EC0 F5        02330 SUBT6    PUSH   AF            ;SAVE THE DIFFERENCE
7EC1 A7        02340          AND    A             ;CLEAR THE CARRY
7EC2 2AF940    02350          LD     HL,(40F9H)
7EC5 E5        02360          PUSH   HL
7EC6 ED4B9F7F  02370          LD     BC,(PRSPS)
7ECA ED42      02380          SBC    HL,BC
7ECC E5        02390          PUSH   HL
7ECD C1        02400          POP    BC       ;BC=TOTAL # OF BYTES TO BE MOVED
7ECE E1        02410          POP    HL
7ECF E5        02420          PUSH   HL       ;HL=END OF BASIC ADDR.
7ED0 D1        02430          POP    DE
7ED1 13        02440          INC    DE       ;DE=END OF BASIC+1
7ED2 EDB8      02450          LDDR            ;MOVE MEMORY FOR 1 NEW CHARACTER
7ED4 2AF940    02460          LD     HL,(40F9H)
7ED7 23        02470          INC    HL
7ED8 22F940    02480          LD     (40F9H),HL  ;FIX END OF BASIC POINTER
7EDB 2AA17F    02490          LD     HL,(NXTLN)
7EDE 23        02500          INC    HL
7EDF 22A17F    02510          LD     (NXTLN),HL  ;FIX NEXT LINE POINTER
7EE2 EB        02520          EX     DE,HL
7EE3 2AB97F    02530          LD     HL,(LNSTRT)
7EE6 73        02540          LD     (HL),E
7EE7 23        02550          INC    HL
7EE8 72        02560          LD     (HL),D
7EE9 CDFC1A    02570          CALL   1AFCH    ;UPDATE ALL NEXT LINE POINTERS
7EEC F1        02580          POP    AF
7EED 3C        02590          INC    A        ;JUMP IF MORE CHARACTERS EXIST
7EEE 20D0      02600          JR     NZ,SUBT6
7EF0 3AA87F    02610 SUBT8    LD     A,(CHRNN)
7EF3 4F        02620          LD     C,A
7EF4 0600      02630          LD     B,0
7EF6 21AB7F    02640          LD     HL,BUFF
7EF9 ED5B9F7F  02650          LD     DE,(PRSPS)   ;MOVE NEW REFERENCE TO
7EFD EDB0      02660          LDIR                ;PROGRAM LINE
7EFF 3AA87F    02670 SUBT9    LD     A,(CHRNN)
7F02 2A9F7F    02680          LD     HL,(PRSPS)
7F05 85        02690          ADD    A,L
7F06 6F        02700          LD     L,A
7F07 3E00      02710          LD     A,0
7F09 8C        02720          ADC    A,H
7F0A 67        02730          LD     H,A      ;POINT TO NEXT CHARACTER
7F0B C9        02740          RET             ;AND RETURN
7F0C F5        02750 SUBT7    PUSH   AF       ;SAVE THE DIFFERENCE
7F0D A7        02760          AND    A
7F0E 2AF940    02770          LD     HL,(40F9H)
7F11 ED4B9F7F  02780          LD     BC,(PRSPS)
7F15 ED42      02790          SBC    HL,BC
7F17 E5        02800          PUSH   HL
7F18 C1        02810          POP    BC       ;BC=TOTAL # OF BYTES TO BE MOVED
7F19 2A9F7F    02820          LD     HL,(PRSPS)
7F1C E5        02830          PUSH   HL       ;HL=PRESENT POSITION
7F1D D1        02840          POP    DE       ;DE=PRESENT POSITION
7F1E 23        02850          INC    HL
7F1F EDB0      02860          LDIR            ;MOVE MEMORY FOR 1 DIGIT
7F21 2AF940    02870          LD     HL,(40F9H)     ;ADJUST END OF BASIC POINTER
7F24 2B        02880          DEC    HL
```

```
7F25 22F94Ø   Ø289Ø           LD      (4ØF9H),HL
7F28 2AA17F   Ø29ØØ           LD      HL,(NXTLN)
7F2B 2B       Ø291Ø           DEC     HL
7F2C 22A17F   Ø292Ø           LD      (NXTLN),HL      ;ADJUST NEXT LINE POINTER
7F2F EB       Ø293Ø           EX      DE,HL
7F3Ø 2AB97F   Ø294Ø           LD      HL,(LNSTRT)
7F33 73       Ø295Ø           LD      (HL),E
7F34 23       Ø296Ø           INC     HL
7F35 72       Ø297Ø           LD      (HL),D
7F36 CDFC1A   Ø298Ø           CALL    1AFCH       ;UPDATE ALL NEXT LINE POINTERS
7F39 F1       Ø299Ø           POP     AF
7F3A 3D       Ø3ØØØ           DEC     A
7F3B 2ØCF     Ø3Ø1Ø           JR      NZ,SUBT7        ;JUMP IF MORE DIGITS EXIST
7F3D 18B1     Ø3Ø2Ø           JR      SUBT8     ;GO PUT NEW REFERENCE IN LINE
7F3F D1       Ø3Ø3Ø SUEXT     POP     DE
7F4Ø 2A9F7F   Ø3Ø4Ø           LD      HL,(PRSPS)      ;EXIT SUBSTITITE MODE
7F43 C9       Ø3Ø5Ø           RET
              Ø3Ø6Ø ;*****************************************
              Ø3Ø7Ø ;*                NCHK
              Ø3Ø8Ø ;*  1. COUNTS THE NUMBER OF ASCII
              Ø3Ø9Ø ;*  CHARACTERS POINTED TO BY HL-REGISTER
              Ø31ØØ ;*****************************************
7F44 ØEØØ     Ø311Ø NCHK      LD      C,Ø
7F46 2B       Ø312Ø           DEC     HL
7F47 D7       Ø313Ø NCH2      RST     1ØH       ;TEST CHARACTER
7F48 DØ       Ø314Ø           RET     NC        ;RETURN IF NOT NUMERIC
7F49 ØC       Ø315Ø           INC     C         ;INCREMENT COUNT
7F4A 18FB     Ø316Ø           JR      NCH2      ;CONTINUE
              Ø317Ø ;*****************************************
              Ø318Ø ;*                FIXCHR
              Ø319Ø ;*  1. FIXES ASCII # SO THAT IT IS IN
              Ø32ØØ ;*  THE CORRECT FORM FOR USE IN SUBTT
              Ø321Ø ;*****************************************
7F4C ØEØØ     Ø322Ø FIXCHR    LD      C,Ø
7F4E 21AB7F   Ø323Ø           LD      HL,BUFF
7F51 2B       Ø324Ø FIXCH1    DEC     HL
7F52 D7       Ø325Ø           RST     1ØH       ;TEST CHARACTER
7F53 DØ       Ø326Ø           RET     NC        ;RETURN IF NOT NUMERIC
7F54 FE3Ø     Ø327Ø           CP      3ØH
7F56 28Ø5     Ø328Ø           JR      Z,FIXCH3        ;JUMP IF IT IS AN ASCII ZERO
7F58 ØC       Ø329Ø FIXCH2    INC     C
7F59 D7       Ø33ØØ           RST     1ØH       ;COUNT UNTIL NON-NUMERIC
7F5A DØ       Ø331Ø           RET     NC        ;CHARACTER IS FOUND
7F5B 18FB     Ø332Ø           JR      FIXCH2
7F5D E5       Ø333Ø FIXCH3    PUSH    HL        ;ROTATE NUMBER LEFT TO
7F5E C5       Ø334Ø           PUSH    BC        ;DELETE LEADING ZEROS
7F5F D5       Ø335Ø           PUSH    DE
7F6Ø Ø1Ø5ØØ   Ø336Ø           LD      BC,ØØØ5
7F63 E5       Ø337Ø           PUSH    HL
7F64 D1       Ø338Ø           POP     DE
7F65 23       Ø339Ø           INC     HL
7F66 EDBØ     Ø34ØØ           LDIR
7F68 D1       Ø341Ø           POP     DE
7F69 C1       Ø342Ø           POP     BC
7F6A E1       Ø343Ø           POP     HL
7F6B 18E4     Ø344Ø           JR      FIXCH1    ;GET NEXT CHARACTER
              Ø345Ø ;*****************************************
              Ø346Ø ;*                UPDATE
              Ø347Ø ;*  1. UPDATES THE ACTUAL LINE NUMBERS
              Ø348Ø ;*
              Ø349Ø ;*****************************************
7F6D 2A9B7F   Ø35ØØ UPDATE    LD      HL,(INCR)
```

Program continued

```
7F70 EB         03510        EX    DE,HL
7F71 2A997F     03520        LD    HL,(START)     ;UPDATE ALL LINE #S
7F74 A7         03530        AND   A
7F75 ED52       03540        SBC   HL,DE
7F77 22B77F     03550        LD    (TOTAL),HL     ;TOTAL = START - INCR
7F7A 2A9D7F     03560        LD    HL,(STRBSC)
7F7D 5E         03570 UPDAT1 LD    E,(HL)    ;FIND NEXT LINE ADDR.
7F7E 23         03580        INC   HL
7F7F 56         03590        LD    D,(HL)
7F80 7B         03600        LD    A,E
7F81 B2         03610        OR    D
7F82 C8         03620        RET   Z        ;RETURN IF DONE
7F83 D5         03630        PUSH  DE
7F84 23         03640        INC   HL
7F85 E5         03650        PUSH  HL
7F86 2A9B7F     03660        LD    HL,(INCR)      ;CALCULATE LINE #
7F89 EB         03670        EX    DE,HL
7F8A 2AB77F     03680        LD    HL,(TOTAL)     ;TOTAL = TOTAL + INCR
7F8D 19         03690        ADD   HL,DE
7F8E 22B77F     03700        LD    (TOTAL),HL
7F91 EB         03710        EX    DE,HL
7F92 E1         03720        POP   HL
7F93 73         03730        LD    (HL),E      ;LINE # = TOTAL
7F94 23         03740        INC   HL
7F95 72         03750        LD    (HL),D
7F96 E1         03760        POP   HL       ;POINT TO NEXT LINE
7F97 18E4       03770        JR    UPDAT1      ;CONTINUE
0002            03780 START  DEFS  2        ;STARTING LINE #
0002            03790 INCR   DEFS  2        ;INCREMENT
0002            03800 STRBSC DEFS  2        ;ADDR. OF START OF BASIC PROG.
0002            03810 PRSPS  DEFS  2        ;PRESENT POSITION
0002            03820 NXTLN  DEFS  2        ;NEXT LINE
0002            03830 LNNUM  DEFS  2        ;LINE NUMBER
0002            03840 LNREF  DEFS  2        ;LINE REFERENCE
0001            03850 CHRNO  DEFS  1        ;# OF DIGITS IN OLD REFERENCE
0001            03860 CHRNN  DEFS  1        ;# OF DIGITS IN NEW REFERENCE
0002            03870 NWLNM  DEFS  2        ;NEW LINE REFERENCE
0004            03880 BUFF   DEFS  4
7FAF 0000       03890        DEFW  00
0004            03900 KBUFF  DEFS  4
7FB5 0000       03910        DEFW  00
0002            03920 TOTAL  DEFS  2
0002            03930 LNSTRT DEFS  2        ;STARTING LINE
7D5D            03940        END   BEGIN
00000 TOTAL ERRORS
```

21

Complete Variable Lister

by John M. Hammang

System Requirements:
Level II BASIC
Model I
16K RAM

With John Webster's variable lister article (*80 Microcomputing*, July 1981), I could finally document all my TRS-80 programs. Unfortunately, Mr. Webster's program fails to list the array variables. My modification of it does.

The key to listing these variables is to jump from array name to array name without stumbling over the intervening data and string pointers. The first array name immediately follows the last simple variable name.

Each array describes its contents with the following format. The first byte indicates variable type (2 = integer, 3 = string, 4 = single precision, and 8 = double precision). The next two bytes are the ASCII values of the variable name in reverse order. For instance, if your variable is named AB, the B appears first (66) and the A appears second (65). The HL register in the Z80 microprocessor reverses them when it retrieves the values for processing. The fourth and fifth bytes specify the total number of bytes which occur after the fifth byte. These two values, added together, determine the size of the array and are also reversed. The value in the fourth byte is multiplied by one. This is the least significant byte (LSB). The value in the fifth byte is multiplied by 256 (the decimal equivalent of the third place value of numbers in the hexadecimal numbering system). This fifth byte is the most significant byte (MSB). When you add the fourth and fifth bytes you know how far to jump, in decimal form, to the next array variable name.

This gives you the basic array names. The sixth byte tells how many dimensions this array has and each following pair of bytes tells the size

or depth of each dimension in the array. Thus you can determine and report not only the number of dimensions for each array but the size of each dimension.

The dimension size byte pairs are reversed for normal Z80 operations. The sequence of dimension sizes is also stored in reverse order. For example, if you dimension AB(3,4,5), Level II will store the third size (5) first, the second size (4) next, and the first size (3) last. The Complete Variable Lister also reports the dimension sizes in reverse order.

The first part of the program listing approximates Mr. Webster's. Line 65000 finds the start of the simple variable storage area and dimensions a terminating test array. Line 65010 establishes the variable name values and checks for variable name ZV (the first variable name used in this routine). The first time this variable name is encountered, ZU is incremented and the program flows to the array listing routines. For an explanation of how the first segment of this program works, see page 259 of the July 1981 issue of *80 Microcomputing*.

When you find the ZV variable name the first time, 35 is added to the PEEK pointer value (the value of ZV + 35), to jump over the simple variable names in this program. I use five single precision variables (5*7 = 35). As in the first segment, the program prints the type of data in the array and the variable name. Line 65120 reports the number of dimensions (PEEK(ZV + 5)). Next, the program enters a FOR-NEXT loop to report the size of each dimension. Dimension size is computed (LSB*1) + (MSB*256) and printed in reverse order. Line 65140 computes the jump to the next array variable name and returns to the start of the reporting routine in line 65020. Five is added to the computed jump value in line 65140 because the array size, stored in bytes 4 and 5 of the array variable, reports only the number of bytes following the array size information.

This program uses very high line numbers so you can add this Complete Variable Lister to existing programs without renumbering. It also uses unusual variable names to avoid conflicts with variable names utilized in object programs.

1. CLOAD the object program
2. PRINT PEEK(16633),PEEK(16634) and write down the results
3. If PEEK(16633)≥2 then go to step 5
4. If PEEK(16633)<2 then POKE 16548, PEEK(16633) + 254: POKE16549,PEEK(16634) – 1 then go to step 6
5. POKE 16548,PEEK(16633) – 2: POKE 16549,PEEK(16634)
6. CLOAD the Complete Variable Lister program
7. POKE 16548,233: POKE 16549,66
8. Run the object program with all its subroutines and variations
9. BREAK and GOTO 65000 to execute the Complete Variable Lister

Figure 1. *How to merge the Complete Variable Lister with your object program*

Use the procedure listed in Figure 1 to add this program to the program for which you want the list of variables. Complete step 7 before listing the combined programs. Step 7 is a call to the Level II merge function. You have to run the object program with all its subroutines and variations to find all the variables.

The Level II manual erroneously states that the number and size of dimensions are limited only by the amount of memory available. The data pattern for array names and sizes limits the number of dimensions to 255 and a dimension's depth to 32,768.

The Complete Variable Lister program reports all simple and array variables with any type of data as well as the number and size of each array dimension. All arrays are reported whether directly dimensioned in the program or dimensioned by default.

Program Listing

```
64950 '*** COMPLETE VARIABLE LISTER ***'
64960 'BY: JOHN M. HAMMANG
64970 '21730 CHIPMUNK TRAIL EAST
64980 'WOODHAVEN, MICHIGAN 48183
64990 'VERSION 1.0
65000 ZV=PEEK(16633)+256*PEEK(16634):DIMZV$(1):ZU=1:LPRINT"    *
* * SIMPLE VARIABLES * * *":LPRINTCHR$(138)
65010 ZW=PEEK(ZV):ZX=PEEK(ZV+1):ZY=PEEK(ZV+2):IFZX=86ANDZY=90THE
NZU=ZU+1:GOSUB65160:GOTO65010
65020 LPRINTCHR$(ZY);CHR$(ZX);:GOSUB65030:LPRINT" ":LPRINTCHR$(1
38):GOTO65010
65030 IFZW=2THENLPRINT" % INTEGER";:GOTO65070
65040 IFZW=3THENLPRINT"$";:GOTO65070
65050 IFZW=4THENLPRINT" ! SINGLE PRECISION";:GOTO65070
65060 IFZW=8THENLPRINT" # DOUBLE PRECISION";:GOTO65070
65070 ONZUGOTO65080,65120
65080 IFZW=2THENZV=ZV+5:RETURN
65090 IFZW=3THENLPRINTPEEK(ZV+3);"CHAR. LONG";:ZV=ZV+6:RETURN
65100 IFZW=4THENZV=ZV+7:RETURN
65110 IFZW=8THENZV=ZV+11:RETURN
65120 LPRINT" ARRAY WITH";PEEK(ZV+5);"DIMENSION(S)":ZW=ZV+5
65130 FORZX=PEEK(ZV+5)TO1STEP-1:LPRINTTAB(5)"DIM SIZE NO.";ZX;"I
S";(PEEK(ZW+1)+(PEEK(ZW+2)*256))-1;"ELEMENTS":ZW=ZW+2:NEXTZX
65140 ZV=ZV+(PEEK(ZV+3)+(PEEK(ZV+4)*256))+5:RETURN
65160 IFZU=2THENZV=ZV+35:LPRINT" ":LPRINT"    * * * ARRAY VARIABL
ES * * *":RETURN
65170 IFZU=3THENLPRINT" ":LPRINTCHR$(138):LPRINT"ALL VARIABLES L
ISTED":END
```

22

MODSTRING for Packing Strings

by T.A. Wells

System Requirements:
Model I
16K RAM
Level II BASIC

MODSTRING, a utility written in BASIC, can be merged with another BASIC program. It enables you to pack strings for faster graphics or embed machine language in a BASIC program. With MODSTRING, you can pack, modify, and display strings wthout typing and later deleting FOR-NEXT loops, DATA statements, and POKE statements.

MODSTRING works by modifying itself. When you type the name of the string to be packed or modified, MODSTRING POKEs that name into one of its own lines, so the VARPTR and LEN functions can be used. After the information is obtained, MODSTRING unmodifies itself, to allow another string to be processed.

How to Use MODSTRING

If you have a disk system, it's easy. First load your program, in which you have put dummy strings. Make sure you don't use line numbers higher than 59999. Then merge MODSTRING with it. If you do not have a disk system, you will need a separate utility program that allows the merging of two BASIC programs.

After merging, run your program. When it has passed through all lines containing dummy strings, BREAK the program. This assures that the BASIC interpreter has positioned your string variables in memory just above the end of the program.

Type GOTO 60000. You are prompted from here on by MODSTRING. Type the name of the string. The ENTER key is not needed in

any part of MODSTRING. Answer the other prompts and your string should print, or list on the screen. You must list the string to modify it. If you have printed it, press L. The listed string is in the form BYTE#>VALUE. When you press M, you are asked for the number of the byte you wish to modify. Three digits must be pressed. For example, to change byte 7, press 007. You are then asked for a value from 1 to 255 (except 34, the ASCII value for a quotation mark).

Here is an example to try. Load MODSTRING and type the following lines:

```
100 A$ = "1234567890"
200 EX$(3) = "12345678901234567890"
```

Run the program. When the first prompt appears, press the space bar, then A. Answer the subscript quesion with N. Press P to print the length of the string (10). Below that, 1234567890 should appear. Now press L. The contents of the string (A$) should appear in the BYTE#>VALUE format. Press M; to modify the first byte, press 001. Select a value, say 191, and type it. This value appears next to the 1> near the upper left of the screen. Now press P. The string starts with the graphics block.

For fun, press Q, then type LIST 100. The line is now: 100 A$ = "USING234567890". The value 191 is the computer's code for the USING keyword. When you print the string, the graphics character is always printed. Now run MODSTRING again. List and modify EX$(3) in the same way, but press Y in response to the subscript prompt, then press 3.

Program Limitations

There are some restrictions which must be observed when using this program. Don't try to modify the program unless you understand it

Variable Name	Use
PQ%	Loop counter
PS%, PS!	Pointer to end of BASIC program
P1$, P2$, P3$, P4$	INKEY$ variables to input string name and choice of process
P5$, P5%	New value for byte to be modified
PZ!, PZ%	Location of string in memory
PP$	Name of string to be processed
PL%	Length of string being processed
PA%	Length of string being processed, minus one
PP!, PP%	Pointer to location of string in memory
PI%	Counter for byte number of string being processed
P1%	Counter variable
P4%	Byte position in string

Figure 1. *Variables*

completely. If you do modify it, or just type it in, save a copy before you run it.

String length can't be changed by MODSTRING. You should decide beforehand how long your strings must be. The longest string possible is 104 characters. If you like a challenge, try increasing the maximum length to 240 characters or so.

Variable names in your program must be different from those I have used (see Figure 1). All variables in MODSTRING have type declarations such as a percent sign (%) or exclamation point (!). This avoids confusion with variables in your program or such statements as DEFINTA-Z, DEFDBL or DEFSTR, which you are free to use. When in doubt, check the list of variables.

Do not manipulate any string that is or will be packed.

This program has only been verified on Radio Shack hardware tape and disk (with TRSDOS 2.3) systems. Any other hardware or operating systems that change the end-of-program pointers (16633,4) will produce problems.

Line-by-Line Program Description

60000 Ask for name of string variable to be processed.
60005 Subroutine to replace PP$ in the LEN and VARPTR statements in line 62000.
60009-60010 Get first letter of string variable name.
60020 Get second letter of string variable name. Put first plus second letters into PP$.
60022-60027 Ask if the string variable is subscripted. If so, get the value of the subscript and put the whole variable name into PP$.
60030-60040 Print or list option.
60060 Initialize variables. This keeps ROM from moving them around in later steps.
60100 Go to the heart of the program.
60200-60201 Set up pointers for the PEEK statements to follow.
60202 Reject string variables with LEN>104 bytes.
60208-60232 Print or list the contents of the variable.
60240-60250 Ask operator for next instruction.
60260-60320 If modify is selected, modify the screen display and the variable.
60330 Go back for further instructions.
61000 Find the end of the BASIC program. Memory locations 16633 and 16634 contain the pointer.
61220 STEP from the end of the program toward the front looking for "PP$" (in ASCII, PP$ is 80, 80, and 36). When found, exit to the next statement.
61900 POKE the name of the variable sought into the next BASIC

line, replacing the two occurrences of PP$ in line 62000 with the name of the variable the operator has specified. One is the argument of the LEN statement at the beginning of the line and the other is the argument of the VARPTR statement near the end. The blanks in line 62000 following each occurrence of PP$ are significant. They provide room for POKEing the name of a subscripted variable.

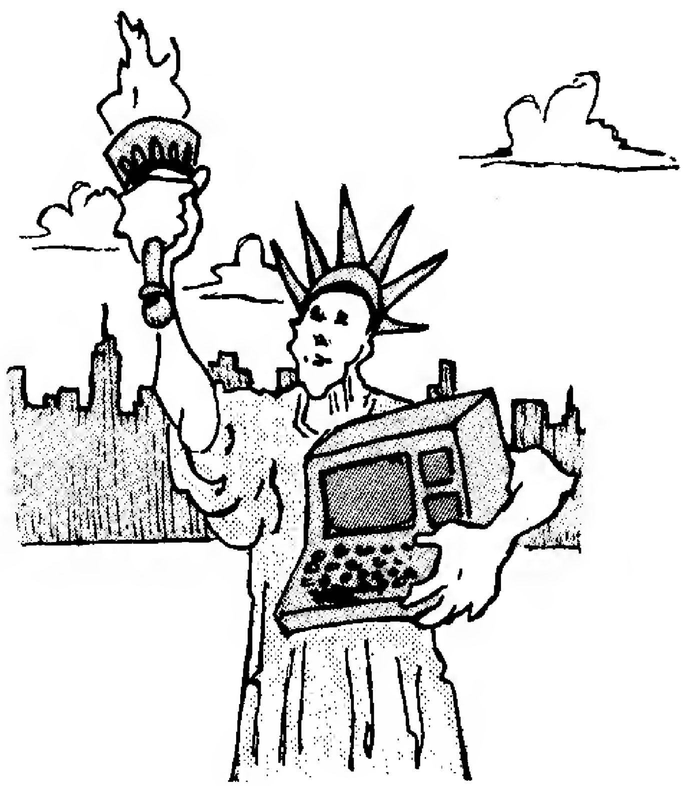
62000 Find the length of the requested function. If it's less than one, put the PP$ back into line 62000, print an error message and go get another name. If the length is okay, get PP!, the pointer to the variable in memory. Put the PP$ back into line 62000, then go process the variable (print, list or modify).

Program Listing

```
59998 REM          ** MODSTRING **
59999 REM - STRING MODIFICATION PROGRAM - COPYRIGHT 1981
           T. A. WELLS - N.O., LA. 70118
60000 CLS:PRINT"STRING MODIFICATION PROGRAM":PRINT:PRINT"ENTER T
HE NAME OF THE STRING USING ONLY ONE OF THESE 3 FORMATS:
<SPACE><LETTER> - <LETTER><LETTER> - <LETTER><NUMBER>
        ----> ? ";:GOTO60009
60005 FORPQ%=1TO2:POKEPS%-3+PQ%,80:POKEPS%-124+PQ%,80:NEXT:POKEP
S%,36:POKEPS%-121,36:FORPQ%=4TO6:POKEPS%-3+PQ%,32:POKEPS%-124+PQ
%,32:NEXT:RETURN
60009 P1$=INKEY$
60010 P1$=INKEY$:IF(P1$<"A"ORP1$>"Z")ANDP1$<>" "THEN60010ELSEPRI
NTP1$;:P2$=INKEY$
60020 P2$=INKEY$:IF(P2$>"/"ANDP2$<":"ANDP1$<>" ")OR(P2$>"@"ANDP2
$<"[")THENPP$=P1$+P2$+"$":PRINTP2$"$"ELSE60020
60022 PRINT"IS "PP$" SUBSCRIPTED (Y/N)?":P1$=INKEY$
60024 P1$=INKEY$:IFP1$="N"THENPP$=PP$+"    ":GOTO60030ELSEIFP1$="
Y"THENPP$=PP$+"("ELSE60024
60026 PRINT"VALUE OF SUBSCRIPT (0-9)?";:P1$=INKEY$
60027 P1$=INKEY$:IFP1$<"0"ORP1$>"9"THEN60027ELSEPP$=PP$+P1$+")"
60030 PRINT@0,CHR$(31)"<P>RINT "PP$" -OR- <L>IST ITS CONTENTS?"
60040 P1$=INKEY$:IFNOT(P1$="P"ORP1$="L")THEN60040
60060 PL%=0:PP%=0:PP!=0:PS%=0:PS!=0:PA%=0:PI%=0:PZ!=0:PZ%=0:P3$=
"":P4$="":P5$="":P1%=0:P4%=0:P5%=0:PQ%=0:PQ$=""
60100 GOTO61000
60200 PA%=PL%-1:PI%=1:IFPP!>32767THENPP%=65536-PP!ELSEPP%=PP!
60201 PZ!=PEEK(PP%+1)+256*PEEK(PP%+2):IFPZ!>32767THENPZ%=PZ!-655
36ELSEPZ%=PZ!
60202 IFPL%>104THENPRINTPP$" IS TOO LONG - IT HAS"PL%"CHARACTERS
.
 MAXIMUM IS 104 CHARACTERS.":FORPQ%=1TO1111:NEXTPQ%:GOTO60000
60208 PRINT"LEN("PP$")="PL%
60210 FORPS%=PZ%TOPZ%+PA%
60220 IFP1$="L"THENPRINTUSING"###";PI%;:PRINT">";:PRINTUSING"###
";PEEK(PS%);:PRINT" ";:PI%=PI%+1
60230 IFP1$="P"THENPRINTCHR$(PEEK(PS%));:PI%=PI%+1
60232 NEXT
60240 PRINT@960,"<A>NOTHER STRING  <Q>UIT ";:IFP1$="P"THENPRINT"
```

Program continued

```
 <L>IST ? ";ELSEPRINT"<P>RINT  <M>ODIFY  ? ";
60250 P3$=INKEY$:IFP3$="M"ANDP1$="L"THEN60260ELSEIFP3$="L"ANDP1$
="P"THENCLS:P1$="L":PRINT:GOTO60200ELSEIFP3$="P"ANDP1$="L"THENCL
S:PRINT:P1$="P":GOTO60200ELSEIFP3$="Q"THENENDELSEIFP3$="A"THEN60
000ELSE60250
60260 PRINT@960,CHR$(30);"MODIFY WHICH BYTE (001 TO ";STRING$(4-
LEN(STR$(PL%)),"0")RIGHT$(STR$(PL%),LEN(STR$(PL%))-1)") ?";
60270 P4$="":FORP1%=1TO3:P3$=""
60280 P3$=INKEY$:IFP3$>"9"ORP3$<"0"THEN60280ELSEP4$=P4$+P3$:PRIN
TP3$;:NEXT:P4%=VAL(P4$):IFP4%<1ORP4%>PL%THEN60260
60290 PRINT@960,CHR$(30);"NEW VALUE FOR BYTE #"P4%" = ? ";
60300 P5$="":FORP1%=1TO3:P4$=""
60310 P4$=INKEY$:IFP4$>"9"ORP4$<"0"THEN60310ELSEP5$=P5$+P4$:PRIN
TP4$;:NEXT:P5%=VAL(P5$):IFP5%=0ORP5%=34ORP5%>255THEN60290
60320 POKEPZ%+P4%-1,P5%:FORP1%=0TO2:POKE15360+132+P1%+8*(P4%-1),
ASC(MID$(P5$,P1%+1,1)):NEXT
60330 GOTO60240
61000 PS!=PEEK(16633)+256*PEEK(16634):IFPS!>32767THENPS%=PS!-655
36ELSEPS%=PS!
61220 FORPP%=PS%TOPS%-100STEP-1:IFPEEK(PP%)=36ANDPEEK(PP%-1)=80A
NDPEEK(PP%-2)=80THEN61900ELSENEXT
61900 FORPQ%=1TO6:POKEPP%+PQ%-3,ASC(MID$(PP$,PQ%,1)):POKEPP%-124
+PQ%,ASC(MID$(PP$,PQ%,1)):NEXT
62000 PS%=PP%:PL%=LEN(PP$    ):IFPL%<1THENPRINT"ERROR - STRING HA
S TO BE DEFINED ALREADY & HAVE A LENGTH > 0 ...":FORPQ%=1TO1670:
NEXTPQ%:GOSUB60005:GOTO60000ELSEPP!=VARPTR(PP$    ):GOSUB60005:GO
TO60200
```



23

PASSWORD Utility

by Craig A. Lindley

System Requirements:
Model I
16K RAM
Editor/assembler
One disk drive
TRSDOS

PASSWORD lets you lock or unlock password protection so you can investigate the system, FORMAT/CMD, BACKUP/CMD and BASIC/CMD files. You can also perform many other operations while the system disk in drive 0 has its password protection unlocked. You can copy, kill, print, and list all those files that until now were only entries in your directories.

How the Program Works

PASSWORD patches the SYS2/SYS file. This file is called up as an overlay anytime the operating system tries to open a file for access. In order to open a file, the operating system must calculate a password code (two bytes in length) from the password specified in the disk control block (DCB). Subroutine CALPW (see Program Listing) contains the code to do this. The calculated password code is compared to the password code stored in the directory entry for the specified file. Usually, if the two match, the file opens and control passes back from the open routine to the calling program, with the Z flag set to indicate the operation was completed successfully. If the calculated and stored password codes do not match, the open routine ends, and an error message code passes back to the calling program in the A register, indicating that access to the file was denied. PASSWORD defeats this process by modifying the code contained in the SYS2/SYS file so that the calculated and stored password codes always appear to match. This is done by changing the

relative jump-if-zero instruction to an unconditional jump instruction. The lock procedure replaces the jump-if-zero instruction, restoring password protection.

How to Use PASSWORD

Execute the program by typing PASSWORD while in the DOS command mode. After the sign-on message is displayed, you are prompted to indicate which disk in the system (0–3) to alter. The specified disk must have the SYS2/SYS file resident (it must be a system disk). If not, PASSWORD displays an error message.

The program prompts for the disk master password before performing the unlock/lock operation. If the password you supply is incorrect, the program ends.

It doesn't matter whether the disk in drive 0 is locked. If you enter the correct password, the area normally occupied by the SYS2/SYS file is loaded into memory from the disk drive specified. PASSWORD checks the format of the data to make sure the disk is a system disk. If it isn't, an error message is displayed, and the program ends. If the data format is correct, the program tells whether the specified disk is locked or unlocked and displays a menu showing the following three options:

L—Lock selected disk
U—Unlock selected disk
Q—Quit this program

The lock option restores password protection afforded by the operating system. The unlock option removes it. These functions patch the SYS2/SYS file accordingly and write it back to the specified disk before returning to the operating system. Every time you use the altered disk as a system disk in drive 0, the password protection of all files in the system is unlocked or locked, depending on which option you chose. The quit option returns you to the operating system without altering the selected disk password status. This option allows you to check a disk's status.

Program Listing

```
              00100 ;*******************************************
              00110 ;*****          PASSWORD UTILITY        *****
              00120 ;***             VERSION  1.0              ***
              00130 ;***             AUG 10, 1981              ***
              00140 ;***                 BY                    ***
              00150 ;*****        CRAIG A. LINDLEY         *****
              00160 ;*******************************************
              00170 ;
7000          00180         ORG     7000H
              00190 ;
              00200 ;SYSTEM EQUATES
              00210 ;
```

```
0049            00220 CHRIN   EQU     0049H           ;ROM CHAR IN ROUTINE
033A            00230 CHROUT  EQU     033AH           ;ROM CHAR OUT ROUTINE
01C9            00240 CLRSCN  EQU     01C9H           ;ROM CLEAR SCREEN ROUTINE
4020            00250 CURSOR  EQU     4020H           ;CURSOR STORAGE
0060            00260 DELAY   EQU     0060H           ;ROM DELAY ROUTINE
05D9            00270 LINEIN  EQU     05D9H           ;ROM LINE INPUT ROUTINE
402D            00280 OPSYS   EQU     402DH           ;OP SYS ENTRY POINT
                00290 ;
6FFF            00300 STACK   EQU     $-1
                00310 ;
                00320 ;SYSTEM STORAGE LOCATIONS
                00330 ;
0001            00340 DRIVE   DEFS    1               ;DRIVE # STORAGE
0001            00350 SECTOR  DEFS    1               ;SECTOR # STORAGE
0001            00360 TRACK   DEFS    1               ;TRACK # STORAGE
                00370 ;
                00380 ;COMPARE STRINGS FOR SYS2/SYS - MUST BE CORRECT FOR
                00390 ;PROGRAM OPERATION.
                00400 ;
7003 ED         00410 CMPST1  DEFB    0EDH
7004 52         00420         DEFB    052H
7005 E1         00430         DEFB    0E1H
                00440 ;
7006 21         00450 CMPST2  DEFB    021H
7007 79         00460         DEFB    079H
7008 FE         00470         DEFB    0FEH
                00480 ;
                00490 ;SYSTEM MESSAGES
                00500 ;
7009 913C       00510 MSG1    DEFW    3C91H
700B 55         00520         DEFM    'UNLOCK/LOCK PASSWORD UTILITY'
7027 03         00530         DEFB    3
7028 593D       00540         DEFW    3D59H
702A 52         00550         DEFM    'REV. 1.0'
7032 03         00560         DEFB    3
7033 1C3E       00570         DEFW    3E1CH
7035 42         00580         DEFM    'BY'
7037 03         00590         DEFB    3
7038 553E       00600         DEFW    3E55H
703A 43         00610         DEFM    'CRAIG A. LINDLEY'
704A 03         00620         DEFB    3
704B CD3E       00630         DEFW    3ECDH
704D 44         00640         DEFM    'DRIVE TO BE UNLOCKED/LOCKED (0-3) ? '
7071 00         00650         DEFB    0
                00660 ;
7072 55         00670 MSG2    DEFM    'UNLOCK/LOCK PASSWORD UTILITY'
708E 0D         00680         DEFB    13
708F 0D         00690         DEFB    13
7090 55         00700         DEFM    'UNLOCK/LOCK DISK DRIVE # '
70A9 00         00710         DEFB    0
                00720 ;
70AA 0D         00730 MSG3    DEFB    13
70AB 0D         00740         DEFB    13
70AC 49         00750         DEFM    'INPUT THE DISK MASTER PASSWORD - '
70CD 00         00760         DEFB    0
                00770 ;
70CE 55         00780 MSG4    DEFM    'UNLOCK/LOCK PASSWORD UTILITY'
70EA 0D         00790         DEFB    13
70EB 0D         00800         DEFB    13
70EC 53         00810         DEFM    'SELECTED DISK IS CURRENTLY:  '
```

Program continued

```
71Ø9 ØØ         ØØ82Ø          DEFB    Ø
                 ØØ83Ø ;
71ØA 2A          ØØ84Ø MSG5     DEFM    '*** LOCKED ***'
7118 ØD          ØØ85Ø          DEFB    13
7119 ØØ          ØØ86Ø          DEFB    Ø
                 ØØ87Ø ;
711A 2A          ØØ88Ø MSG6     DEFM    '*** UNLOCKED ***'
712A ØD          ØØ89Ø          DEFB    13
712B ØØ          ØØ9ØØ          DEFB    Ø
                 ØØ91Ø ;
712C ØD          ØØ92Ø MSG7     DEFB    13
712D ØD          ØØ93Ø          DEFB    13
712E 2A          ØØ94Ø          DEFM    '*** OPERATION SELECTION MENU ***'
714E ØD          ØØ95Ø          DEFB    13
714F ØD          ØØ96Ø          DEFB    13
715Ø 2Ø          ØØ97Ø          DEFM    '     L - LOCK SELECTED DISK'
716B ØD          ØØ98Ø          DEFB    13
716C 2Ø          ØØ99Ø          DEFM    '     U - UNLOCK SELECTED DISK'
7189 ØD          Ø1ØØØ          DEFB    13
718A 2Ø          Ø1Ø1Ø          DEFM    '     Q - QUIT THIS PROGRAM'
71A4 ØD          Ø1Ø2Ø          DEFB    13
71A5 ØD          Ø1Ø3Ø          DEFB    13
71A6 57          Ø1Ø4Ø          DEFM    'WHICH ? '
71AE ØØ          Ø1Ø5Ø          DEFB    Ø
                 Ø1Ø6Ø ;
71AF 55          Ø1Ø7Ø MSG8     DEFM    'UNLOCK/LOCK PASSWORD UTILITY'
71CB ØD          Ø1Ø8Ø          DEFB    13
71CC ØD          Ø1Ø9Ø          DEFB    13
71CD 4F          Ø11ØØ          DEFM    'OPERATION COMPLETE'
71DF ØD          Ø111Ø          DEFB    13
71EØ ØD          Ø112Ø          DEFB    13
71E1 ØD          Ø113Ø          DEFB    13
71E2 ØØ          Ø114Ø          DEFB    Ø
                 Ø115Ø ;
                 Ø116Ø ;SYSTEM ERROR MESSAGES
                 Ø117Ø ;
71E3 ØD          Ø118Ø EMSG1    DEFB    13
71E4 ØD          Ø119Ø          DEFB    13
71E5 2A          Ø12ØØ          DEFM    '*** ERROR - IN DISK I/O ***'
72ØØ ØD          Ø121Ø          DEFB    13
72Ø1 ØØ          Ø122Ø          DEFB    Ø
                 Ø123Ø ;
72Ø2 ØD          Ø124Ø EMSG2    DEFB    13
72Ø3 ØD          Ø125Ø          DEFB    13
72Ø4 2A          Ø126Ø          DEFM    '*** ERROR - DRIVE NOT READY ***'
7223 ØD          Ø127Ø          DEFB    13
7224 ØØ          Ø128Ø          DEFB    Ø
                 Ø129Ø ;
7225 ØD          Ø13ØØ EMSG3    DEFB    13
7226 ØD          Ø131Ø          DEFB    13
7227 2A          Ø132Ø          DEFM    '*** ERROR - INCORRECT DISK PASSWORD ***'
724E ØD          Ø133Ø          DEFB    13
724F ØØ          Ø134Ø          DEFB    Ø
                 Ø135Ø ;
725Ø ØD          Ø136Ø EMSG4    DEFB    13
7251 ØD          Ø137Ø          DEFB    13
7252 2A          Ø138Ø          DEFM    '*** ERROR - NOT SYSTEM DISK FORMAT ***'
7278 ØD          Ø139Ø          DEFB    13
7279 ØØ          Ø14ØØ          DEFB    Ø
                 Ø141Ø ;
```

```
                 Ø142Ø ;
                 Ø143Ø ;***** PROGRAM SUBROUTINES *****
                 Ø144Ø ;
                 Ø145Ø ;THIS ROUTINE CALCULATES THE MAIN DISK PASSWORD FROM
                 Ø146Ø ;THE OPERATOR INPUT
                 Ø147Ø ;
727A 21FFFF      Ø148Ø CALPW    LD      HL,-1
727D Ø6Ø8        Ø149Ø          LD      B,8
727F 7B          Ø15ØØ          LD      A,E
728Ø C6Ø7        Ø151Ø          ADD     A,7
7282 5F          Ø152Ø          LD      E,A
7283 3ØØ1        Ø153Ø          JR      NC,PW1
7285 14          Ø154Ø          INC     D
7286 1A          Ø155Ø PW1      LD      A,(DE)
7287 D5          Ø156Ø          PUSH    DE
7288 57          Ø157Ø          LD      D,A
7289 5C          Ø158Ø          LD      E,H
728A 7D          Ø159Ø          LD      A,L
728B E6Ø7        Ø16ØØ          AND     7
728D ØF          Ø161Ø          RRCA
728E ØF          Ø162Ø          RRCA
728F ØF          Ø163Ø          RRCA
729Ø AD          Ø164Ø          XOR     L
7291 6F          Ø165Ø          LD      L,A
7292 26ØØ        Ø166Ø          LD      H,Ø
7294 29          Ø167Ø          ADD     HL,HL
7295 29          Ø168Ø          ADD     HL,HL
7296 29          Ø169Ø          ADD     HL,HL
7297 29          Ø17ØØ          ADD     HL,HL
7298 AC          Ø171Ø          XOR     H
7299 AA          Ø172Ø          XOR     D
729A 57          Ø173Ø          LD      D,A
729B 7D          Ø174Ø          LD      A,L
729C 29          Ø175Ø          ADD     HL,HL
729D AC          Ø176Ø          XOR     H
729E AB          Ø177Ø          XOR     E
729F 5F          Ø178Ø          LD      E,A
72AØ EB          Ø179Ø          EX      DE,HL
72A1 D1          Ø18ØØ          POP     DE
72A2 1B          Ø181Ø          DEC     DE
72A3 1ØE1        Ø182Ø          DJNZ    PW1
72A5 C9          Ø183Ø          RET
                 Ø184Ø ;
                 Ø185Ø ;DISPLAY LINE OUTPUT ROUTINE
                 Ø186Ø ;
72A6 7E          Ø187Ø LOUT     LD      A,(HL)            ;GET CHAR
72A7 B7          Ø188Ø          OR      A                 ;IS IT Ø ?
72A8 C8          Ø189Ø          RET     Z                 ;IF YES THEN
72A9 FEØ3        Ø19ØØ          CP      3                 ;OTHER TERMINATOR
72AB C8          Ø191Ø          RET     Z                 ;IF YES THEN
72AC CD3AØ3      Ø192Ø          CALL    CHROUT            ;DISPLAY IT
72AF 23          Ø193Ø          INC     HL                ;NEXT CHAR
72BØ 18F4        Ø194Ø          JR      LOUT              ;UNTIL FINISHED
                 Ø195Ø ;
                 Ø196Ø ;FORMATTED MESSAGE OUTPUT ROUTINE
                 Ø197Ø ;
72B2 112Ø4Ø      Ø198Ø MSGOUT   LD      DE,CURSOR         ;CURR CURSOR STORAGE
72B5 Ø1Ø2ØØ      Ø199Ø          LD      BC,2              ;MOVE ADDRESS
72B8 EDBØ        Ø2ØØØ          LDIR                      ;INTO CURSOR STORAGE
72BA CDA672      Ø2Ø1Ø          CALL    LOUT              ;DISPLAY LINE
```

Program continued

```
72BD F5       02020          PUSH   AF              ;SAVE TERM CHAR
72BE 3E0F     02030          LD     A,15            ;CURSOR OFF CODE
72C0 CD3A03   02040          CALL   CHROUT          ;OUTPUT IT
72C3 F1       02050          POP    AF              ;RESTORE CHAR
72C4 23       02060          INC    HL              ;NEXT CHAR
72C5 FE00     02070          CP     0               ;END OF MESSAGE ?
72C7 2802     02080          JR     Z,MSGO1         ;YES, FINISH UP
72C9 18E7     02090          JR     MSGOUT          ;UNTIL FINISHED
72CB 3E0E     02100 MSGO1    LD     A,14            ;CURSOR ON CHAR
72CD CD3A03   02110          CALL   CHROUT          ;DO IT
72D0 C9       02120          RET
              02130 ;
              02140 ;RESTORE DRIVE TO TRACK 00 ROUTINE
              02150 ;
72D1 CD0973   02160 RESTOR   CALL   SELDSK          ;SELECT DRIVE
72D4 3E03     02170          LD     A,3             ;SEEK 00 CMD
72D6 32EC37   02180          LD     (37ECH),A       ;GO
72D9 CD0973   02190 RES1     CALL   SELDSK          ;SELECT DRIVE
72DC 3AEC37   02200          LD     A,(37ECH)       ;GET STATUS
72DF 0F       02210          RRCA                   ;BUSY ?
72E0 D0       02220          RET    NC              ;IF NOT THEN
72E1 18F6     02230          JR     RES1            ;LOOP UNTIL NOT BUSY
              02240 ;
              02250 ;SEEK ROUTINE - THIS ROUTINE SETS UP THE SELECTED DISK
              02260 ;WITH A SEEK TO THE SPECIFIED TRACK. ON RETURN, THE
              02270 ;HEAD IS POSITIONED AT TRACK (TRACK), SECTOR (SECTOR).
              02280 ;
72E3 CD0973   02290 SEEK     CALL   SELDSK          ;SELECT THE DRIVE
72E6 21EC37   02300          LD     HL,37ECH        ;POINT AT STATUS/COM REG
72E9 3A0270   02310          LD     A,(TRACK)       ;GET TRACK
72EC 32EF37   02320          LD     (37EFH),A       ;SELECT THE TRACK
72EF 3A0170   02330          LD     A,(SECTOR)      ;GET SECTOR
72F2 32EE37   02340          LD     (37EEH),A       ;SELECT SECTOR
72F5 3E1F     02350          LD     A,1FH           ;SEEK CODE
72F7 77       02360          LD     (HL),A          ;SEEK POSITION
72F8 F5       02370          PUSH   AF
72F9 F1       02380          POP    AF
72FA F5       02390          PUSH   AF
72FB F1       02400          POP    AF              ;WASTE TIME
72FC 7E       02410 CREADY   LD     A,(HL)          ;GET STATUS
72FD 07       02420          RLCA
72FE 3004     02430          JR     NC,CBUSY        ;GO IF READY
7300 E1       02440          POP    HL              ;FIX STACK
7301 C34073   02450          JP     NREADY
              02460 ;
7304 0F       02470 CBUSY    RRCA                   ;ADJ BYTE
7305 0F       02480          RRCA                   ;BUSY BIT TO FLAG
7306 D0       02490          RET    NC              ;IF NOT BUSY THEN
7307 18F3     02500          JR     CREADY          ;ELSE
              02510 ;
              02520 ;SELECT THE DISK DRIVE ROUTINE
              02530 ;
7309 C5       02540 SELDSK   PUSH   BC              ;SAVE "BC"
730A 3A0070   02550          LD     A,(DRIVE)       ;GET DRIVE #
730D 47       02560          LD     B,A             ;"B" IS COUNTER
730E 3E80     02570          LD     A,80H           ;SELECTION BITS
7310 07       02580 SEL1     RLCA                   ;ROTATE
7311 10FD     02590          DJNZ   SEL1            ;UNTIL FINISHED
7313 32E137   02600          LD     (37E1H),A       ;SELECT THE DRIVE
7316 C1       02610          POP    BC              ;RESTORE "BC"
```

```
7317 C9         Ø262Ø          RET
                Ø263Ø ;
                Ø264Ø ;SECTOR READ ROUTINE ENTRY WITH BUFFER IN "BC"
                Ø265Ø ;DRIVE TRACK AND SECTOR NUMBERS ALREADY IN MEMORY
                Ø266Ø ;
7318 CDE372     Ø267Ø SREAD    CALL    SEEK           ;POSITION HEAD FOR
                Ø268Ø                                 ;REQUIRED OPERATION
731B 368C       Ø269Ø READ     LD      (HL),8CH       ;READ COMMAND
731D 11EF37     Ø27ØØ          LD      DE,37EFH       ;POINT TO DATA REGISTER
732Ø F5         Ø271Ø          PUSH    AF
7321 F1         Ø272Ø          POP     AF
7322 F5         Ø273Ø          PUSH    AF
7323 F1         Ø274Ø          POP     AF
7324 18Ø3       Ø275Ø          JR      READ2
                Ø276Ø ;
7326 ØF         Ø277Ø READ1    RRCA                   ;BUSY BIT TO FLAG
7327 3ØØA       Ø278Ø          JR      NC,STATCK      ;BUSY/DONE GO CK STATUS
7329 7E         Ø279Ø READ2    LD      A,(HL)         ;GET STATUS
732A CB4F       Ø28ØØ          BIT     1,A            ;DRQ BIT
732C 28F8       Ø281Ø          JR      Z,READ1        ;GO CHECK BUSY
732E 1A         Ø282Ø READIT   LD      A,(DE)         ;GET DATA BYTE
732F Ø2         Ø283Ø          LD      (BC),A         ;STORE IN BUF1
733Ø Ø3         Ø284Ø          INC     BC             ;NEXT BUF POSITION
7331 18F6       Ø285Ø          JR      READ2          ;GO CK DRQ
7333 7E         Ø286Ø STATCK   LD      A,(HL)         ;GET STATUS
7334 E65C       Ø287Ø          AND     5CH            ;MASK IT
7336 C8         Ø288Ø          RET     Z              ;IF NO ERROR
                Ø289Ø ;
                Ø29ØØ ;DISK ERROR OUTPUT ROUTINE
                Ø291Ø ;
7337 21E371     Ø292Ø DSKERR   LD      HL,EMSG1       ;DISK ERROR MSG
733A CDA672     Ø293Ø ERROR    CALL    LOUT           ;DISPLAY IT
733D C32D4Ø     Ø294Ø          JP      OPSYS          ;BACK TO DOS
734Ø 21Ø272     Ø295Ø NREADY   LD      HL,EMSG2       ;DRIVE NOT READY ERR MSG
7343 18F5       Ø296Ø          JR      ERROR          ;DISPLAY AND ABORT
                Ø297Ø ;
                Ø298Ø ;STRING COMPARISON ROUTINE FOR SYS2/SYS FORMAT VERIFY
                Ø299Ø ;
7345 1A         Ø3ØØØ STRCMP   LD      A,(DE)         ;GET DISK CHAR
7346 BE         Ø3Ø1Ø          CP      (HL)           ;IS IT = TO CMPSTR CHAR ?
7347 2ØØ5       Ø3Ø2Ø          JR      NZ,ERR1        ;IF MISCOMPARE THEN
7349 23         Ø3Ø3Ø          INC     HL             ;INC PTRS
734A 13         Ø3Ø4Ø          INC     DE
734B 1ØF8       Ø3Ø5Ø          DJNZ    STRCMP         ;CHECK ALL 7 CHARS
734D C9         Ø3Ø6Ø          RET                    ;WHEN COMPARE FINISHED
734E E1         Ø3Ø7Ø ERR1     POP     HL             ;FIX STACK
734F 215Ø72     Ø3Ø8Ø          LD      HL,EMSG4       ;FORMAT ERROR MSG
7352 C33A73     Ø3Ø9Ø          JP      ERROR          ;DISPLAY AND ABORT
                Ø31ØØ ;
                Ø311Ø ;WRITE SECTOR ROUTINE
                Ø312Ø ;
7355 CDE372     Ø313Ø SWRITE   CALL    SEEK           ;POSITION HEAD FOR THE
                Ø314Ø                                 ;REQUIRED OPERATION
7358 36AC       Ø315Ø WRITE    LD      (HL),ØACH      ;WRITE CMD
735A 11EF37     Ø316Ø          LD      DE,37EFH       ;POINT TO DATA REGISTER
735D F5         Ø317Ø          PUSH    AF
735E F1         Ø318Ø          POP     AF
735F F5         Ø319Ø          PUSH    AF
736Ø F1         Ø32ØØ          POP     AF             ;WASTE TIME
7361 18Ø3       Ø321Ø          JR      WRITE2
```

Program continued

```
                03220 ;
7363 ØF         03230 WRITE1  RRCA                       ;BUSY BIT TO FLAG
7364 30CD       03240         JR      NC,STATCK          ;BUSY/DONE GO CK STATUS
7366 7E         03250 WRITE2  LD      A,(HL)             ;GET STATUS
7367 CB4F       03260         BIT     1,A                ;DRQ BIT
7369 28F8       03270         JR      Z,WRITE1           ;GO CHECK BUSY
736B ØA         03280 WRITIT  LD      A,(BC)             ;GET BYTE
736C Ø3         03290         INC     BC                 ;POINT TO NEXT
736D 12         03300         LD      (DE),A             ;STORE ON DISK
736E 18F6       03310         JR      WRITE2             ;GO CHECK DRQ
                03320 ;
                03330 ;WAIT ROUTINE - THIS ROUTINE SELECTS THE SPECIFIED DISK
                03340 ;DRIVE AND WAITS FOR IT TO COME UP TO SPEED BEFORE
                03350 ;RETURNING TO THE CALLING PROGRAM.
                03360 ;
7370 CDØ973     03370 WAIT    CALL    SELDSK             ;SELECT THE DRIVE
7373 Ø1ØØØØ     03380         LD      BC,Ø               ;MAX DELAY
7376 CD6ØØØ     03390         CALL    DELAY              ;ROM ROUTINE
7379 C9         03400         RET
                03410 ;
                03420 ;***********************************
                03430 ;***** START OF MAIN PROGRAM *****
                03440 ;***********************************
                03450 ;
737A F3         03460 START   DI                         ;DISABLE INTERRUPTS
737B 31FF6F     03470         LD      SP,STACK           ;LOAD STACK PTR
737E CDC9Ø1     03480         CALL    CLRSCN             ;CLEAR DISPLAY
7381 21Ø97Ø     03490         LD      HL,MSG1            ;SIGN ON MESSAGE
7384 CDB272     03500         CALL    MSGOUT             ;DISPLAY IT
7387 CD49ØØ     03510 ASK     CALL    CHRIN              ;GET RESPONSE
738A FE34       03520         CP      '4'                ;MAX + 1
738C 3ØF9       03530         JR      NC,ASK             ;ERROR IF > 3
738E FE3Ø       03540         CP      'Ø'                ;MIN
739Ø 38F5       03550         JR      C,ASK              ;ERROR IF < Ø
7392 F5         03560         PUSH    AF                 ;SAVE ASCII DRIVE #
7393 D63Ø       03570         SUB     3ØH                ;CONVERT TO HEX
7395 3C         03580         INC     A                  ;ADD ONE TO DRIVE NUMBER
7396 32ØØ7Ø     03590         LD      (DRIVE),A          ;STORE DRIVE NUMBER
                03600 ;
                03610 ;ANSWER IN RANGE CONTINUE
                03620 ;
7399 CDC9Ø1     03630         CALL    CLRSCN             ;CLEAR DISPLAY
739C 21727Ø     03640         LD      HL,MSG2            ;MSG
739F CDA672     03650         CALL    LOUT               ;DISPLAY IT
73A2 F1         03660         POP     AF                 ;RESTORE ASCII DRIVE #
73A3 CD3AØ3     03670         CALL    CHROUT             ;DISPLAY IT
                03680 ;
                03690 ;READ THE DIRECTORY GAT SECTOR ØØ OF SELECTED DISK DRIVE
                03700 ;
73A6 CD7Ø73     03710         CALL    WAIT               ;WAIT FOR DRIVE TO
                03720                                    ;COME UP TO SPEED
73A9 3E11       03730         LD      A,11H              ;TRK NUM
73AB 32Ø27Ø     03740         LD      (TRACK),A          ;STORE TRK NUM
73AE 3EØØ       03750         LD      A,Ø                ;SECTOR Ø
73BØ 32Ø17Ø     03760         LD      (SECTOR),A         ;STORE SECTOR NUM
73B3 CDD172     03770         CALL    RESTOR             ;SEEK TRK ØØ
73B6 Ø16A74     03780         LD      BC,DBUF            ;SECTOR BUFFER AREA
73B9 CD1873     03790         CALL    SREAD              ;READ GAT IN DIR
                03800 ;
```

```
                 03810 ;ASK FOR DISK PASSWORD ROUTINE
                 03820 ;
73BC 21AA70      03830 ASK1     LD      HL,MSG3         ;REQUEST MSG
73BF CDA672      03840          CALL    LOUT            ;DISPLAY IT
73C2 216A75      03850          LD      HL,INBUF        ;BUF FOR OPERATOR INPUT
73C5 0608        03860          LD      B,8             ;MAX LENGTH OF PASSWORD
73C7 CDD905      03870          CALL    LINEIN          ;GET PASSWORD
73CA 78          03880          LD      A,B             ;LENGTH INTO "A"
73CB B7          03890          OR      A
73CC 28EE        03900          JR      Z,ASK1          ;IF NO INPUT ASK AGAIN
                 03910 ;
73CE EB          03920          EX      DE,HL           ;POINT "DE" AT PASSWORD
73CF 83          03930          ADD     A,E             ;POINT "HL" AT END
73D0 6F          03940          LD      L,A
73D1 7A          03950          LD      A,D
73D2 CE00        03960          ADC     A,0
73D4 67          03970          LD      H,A
73D5 3E08        03980          LD      A,8             ;MAX LENGTH
73D7 90          03990          SUB     B               ;- LENGTH
73D8 47          04000          LD      B,A             ;INTO "B"
73D9 3620        04010 ASK2     LD      (HL),20H        ;STORE BLANKS
73DB 23          04020          INC     HL              ;NEXT POSITION
73DC 10FB        04030          DJNZ    ASK2            ;FILL REMAINDER WITH
                 04040                                  ;BLANK CODE 20H
73DE CD7A72      04050          CALL    CALPW           ;CALCULATED PASSWORD
                 04060                                  ;IN "HL"
                 04070 ;
                 04080 ;COMPARE CALCULATED PASSWORD TO THE ONE STORED IN THE GAT
                 04090 ;SECTOR OF THE SELECTED DISK.
                 04100 ;
73E1 ED5B3875    04110          LD      DE,(DBUF+206)   ;PASSWORD LOCATION IN GAT
73E5 DF          04120          RST     18H             ;COMPARE
73E6 2806        04130          JR      Z,ASK3          ;IF OK THEN
                 04140 ;
73E8 212572      04150          LD      HL,EMSG3        ;ACCESS DENIED MESSAGE
73EB C33A73      04160          JP      ERROR           ;DISPLAY AND ABORT
                 04170 ;
73EE 3E10        04180 ASK3     LD      A,10H           ;SYS2/SYS LOCATION
73F0 320270      04190          LD      (TRACK),A
73F3 3E06        04200          LD      A,6             ;SECTOR NUM
73F5 320170      04210          LD      (SECTOR),A
73F8 CD7073      04220          CALL    WAIT            ;WAIT FOR DRIVE TO
                 04230                                  ;COME UP TO SPEED
73FB 016A74      04240          LD      BC,DBUF         ;SECTOR BUFFER AREA
73FE CD1873      04250          CALL    SREAD           ;READ SYS2/SYS
                 04260 ;
                 04270 ;SYS2/SYS SHOULD NOW BE LOADED. CHECK FORMAT TO BE SURE.
                 04280 ;
7401 210370      04290          LD      HL,CMPST1       ;POINT AT COMPARE STR 1
7404 11CA74      04300          LD      DE,DBUF+96      ;PATCH POINT COMPARE
7407 0603        04310          LD      B,3             ;BYTES TO COMPARE
7409 CD4573      04320          CALL    STRCMP          ;COMPARE THE STRINGS
740C 210670      04330          LD      HL,CMPST2       ;2ND COMPARE STRING
740F 11CE74      04340          LD      DE,DBUF+100     ;PATCH POINT COMPARE
7412 0603        04350          LD      B,3             ;BYTES TO COMPARE
7414 CD4573      04360          CALL    STRCMP          ;COMPARE THE STRINGS
                 04370 ;
                 04380 ;DISPLAY CURRENT STATUS UNLOCKED OR LOCKED
                 04390 ;
```

Program continued

```
7417 CDC9Ø1     Ø44ØØ ASK5    CALL    CLRSCN          ;CLEAR DISPLAY
741A 21CE7Ø     Ø441Ø         LD      HL,MSG4         ;STATUS MSG
741D CDA672     Ø442Ø         CALL    LOUT
742Ø 21CD74     Ø443Ø         LD      HL,DBUF+99      ;PATCH DATA
7423 7E         Ø444Ø         LD      A,(HL)          ;GET DATA
7424 FE28       Ø445Ø         CP      28H             ;LOCKED ?
7426 28Ø5       Ø446Ø         JR      Z,LOCKED
7428 211A71     Ø447Ø         LD      HL,MSG6         ;UNLOCKED MSG
742B 18Ø3       Ø448Ø         JR      DISIT           ;DISPLAY IT
742D 21ØA71     Ø449Ø LOCKED  LD      HL,MSG5         ;LOCKED MSG
743Ø CDA672     Ø45ØØ DISIT   CALL    LOUT            ;DISPLAY STATUS
                Ø451Ø ;
                Ø452Ø ;GET OPERATOR RESPONSE
                Ø453Ø ;
7433 212C71     Ø454Ø         LD      HL,MSG7         ;OPTION MENU
7436 CDA672     Ø455Ø         CALL    LOUT            ;DISPLAY IT
7439 CD49ØØ     Ø456Ø         CALL    CHRIN           ;GET RESPONSE
743C CD3AØ3     Ø457Ø         CALL    CHROUT          ;DISPLAY RESPONSE
743F FE51       Ø458Ø         CP      'Q'             ;QUIT ?
7441 CA2D4Ø     Ø459Ø         JP      Z,OPSYS         ;IF YES THEN
7444 FE4C       Ø46ØØ         CP      'L'             ;LOCK DISK ?
7446 28Ø6       Ø461Ø         JR      Z,LOCK
7448 FE55       Ø462Ø         CP      'U'             ;UNLOCK DISK ?
744A 28Ø6       Ø463Ø         JR      Z,UNLOCK
744C 18C9       Ø464Ø         JR      ASK5            ;IF NONE ASK AGAIN
                Ø465Ø ;
744E 3E28       Ø466Ø LOCK    LD      A,28H           ;PATCH VALUE - LOCK
745Ø 18Ø2       Ø467Ø         JR      PATCH
7452 3E18       Ø468Ø UNLOCK  LD      A,18H           ;PATCH VALUE - UNLOCK
                Ø469Ø ;
                Ø47ØØ ;SYS2/SYS IS LOADED CORRECTLY NOW MAKE PATCH
                Ø471Ø ;
7454 21CD74     Ø472Ø PATCH   LD      HL,DBUF+99      ;PATCH LOCATION
7457 77         Ø473Ø         LD      (HL),A          ;STORE INTO SECTOR DATA
7458 CD7Ø73     Ø474Ø         CALL    WAIT            ;WAIT FOR DRIVE TO
                Ø475Ø                                 ;COME UP TO SPEED
745B Ø16A74     Ø476Ø         LD      BC,DBUF         ;POINT AT SECTOR DATA
745E CD5573     Ø477Ø         CALL    SWRITE          ;SECTOR BACK TO DISK
7461 CDC9Ø1     Ø478Ø         CALL    CLRSCN          ;CLEAR DISPLAY
7464 21AF71     Ø479Ø         LD      HL,MSG8         ;OPERATION COMPLETE MSG
7467 C33A73     Ø48ØØ         JP      ERROR           ;DISPLAY AND ABORT
                Ø481Ø ;
                Ø482Ø ;
Ø1ØØ            Ø483Ø DBUF    DEFS    256             ;SECTOR DATA STORAGE
756A            Ø484Ø INBUF   EQU     $               ;INPUT BUFFER AREA
                Ø485Ø ;
                Ø486Ø ;
737A            Ø487Ø         END     START
ØØØØØ TOTAL ERRORS
```

24

A Better LDOS KSM Builder

by Mike Tipton

System Requirements:
Model I or III
16K RAM
One disk drive
LDOS

One of the most useful features of the LDOS disk operating system is the filter routine, which you can use to enhance the capability of a peripheral driver. The keystroke multiplier (KSM), one of the LDOS filters, lets you build a file of commands or text strings. The file of commands is loaded into memory when KSM is activated. You select each command by pressing CLEAR and an alphabetic key. When programming in BASIC, for example, you might define CLEAR-G to display GOTO. All the 26 letters can define useful BASIC keywords.

The BUILD library command permits you to define KSM files. When you invoke BUILD, it displays a letter of the alphabet. You are to type the text string that is to be assigned to the letter. Each letter is displayed in succession. You can exit before Z, but you must start with A and you cannot skip any letters. BUILD has no editing capabilities. If you make an error, you must start over at A. This makes the BUILD utility awkward to use, but I solved this problem by writing a short program in BASIC (see Program Listing) that allows you to both create and edit KSM files. It only takes a few minutes to type it into your system. Comments were left out to make the typing easier, but it is short enough that you should be able to figure out how it works.

The first prompt is (B)UILD NEW FILE OR (R)EVISE OLD. If you type R you are asked for the name of the file you wish to revise. If you type B the program goes directly to the build and edit function. The next prompt is WHICH LETTER. If you type a single letter (A–Z), the program displays the text associated with the letter, if any, and permits you to change it. If no change is desired, press ENTER; otherwise, type the text you want. This process repeats as often as necessary.

There are also four commands you can use to respond to the prompt:

PRINT—Prints all your definitions on a line printer. The printout can be saved for future reference. Make certain that your printer is on-line before using this command. The computer will lock up if it is not.

LIST—Displays all your definitions on the CRT.

SAVE—Allows you to write your new KSM file to the disk. You are asked for a file name.

LOAD—Allows you to load and edit a new KSM file. The current file in memory is destroyed.

Program Listing

```
20 CLS : PRINT@384,  "KSM BUILD UTILITY"
40 CLEAR 2000
60 DEFINT A-Z: DIM AA$(26)
80 INPUT "(B)UILD NEW FILE OR (R)EVISE OLD"; T$
100 IF T$="B" THEN GOTO 260:
120 IF T$="R" THEN GOTO 160
140 GOTO 80
160 INPUT "FILENAME";T$
180 OPEN "I",1,T$
200 FOR J=1 TO 26: INPUT #1,AA$(J): NEXT J
220 CLOSE 1
240 GOTO 280
260 FOR J=1 TO 26: AA$(J)=" ": NEXT J
280 LINEINPUT "WHICH LETTER  ";T$
300 IF T$="" THEN PRINT "ERROR": GOTO 280
320 IF T$="PRINT" THEN GOTO 640
340 IF T$="LIST" THEN GOTO 720
360 IF T$="SAVE" THEN GOTO 540
380 IF T$="LOAD" THEN GOTO 160
400 IF LEN(T$)>1 THEN PRINT "ERROR": GOTO 280
420 T=ASC(LEFT$(T$,1))-64
440 IF T<1 OR T>27 THEN PRINT "ERROR": GOTO 280
460 PRINT T$;"=";AA$(T)
480 PRINT T$;"=?";:T$="":LINEINPUT T$
500 IF T$<>"" THEN AA$(T)=T$
520 GOTO 280
540 INPUT "FILE NAME";F$
560 OPEN "O",1,F$
580 FOR J=1 TO 26: PRINT #1,AA$(J): NEXT J
600 CLOSE 1
620 GOTO 280
640 FOR J=1 TO 26
660 LPRINT CHR$(J+64);"=";AA$(J)
680 NEXT J
700 GOTO 280
720 FOR J=1 TO 26
740 PRINT CHR$(J+64);"=";AA$(J),
760 NEXT J
780 PRINT
800 GOTO 280
```

25

T-EDASM: Link T-BUG and EDTASM

by Ron Anderson

System Requirements:
Level II BASIC
Model I
16K RAM
Radio Shack EDTASM and T-BUG

Are you tired of loading and reloading EDTASM and T-BUG again and again to assemble and debug *one* simple machine-language program? I was, until I developed a program, T-EDASM, that links these two utilities (EDTASM and T-BUG) into a unified assembly and checkout program.

T-EDASM lets you jump between EDTASM and T-BUG with single commands, and loads assembled object code directly into memory from EDTASM. No tape and play sequence is required. You only have to load your machine-language program once to fully develop, test, and debug it.

To use T-EDASM, load the single tape program and enter EDTASM. To move to T-BUG, type the new command B and press ENTER. To return to EDTASM, press A. T-EDASM gives T-BUG two other new commands. The I command tells EDTASM to dump object code in memory. Instead of producing an object code on tape (A command plus two ENTERs), it puts the code directly into memory at the ORG indicated in the code. The E command converts EDTASM to the normal tape dump mode again. After an EDTASM assemble command, the prompt READY CASSETTE appears in the E mode. In the I mode, however, the prompt is READY TO STORE.

Here is a typical programming session with T-EDASM. Develop your program using EDTASM, hop to T-BUG (with B), convert to internal load, and move back to EDTASM (I) to assemble and load the code into memory. Next, go back to T-BUG (B) and use it on your new program now in memory. Repeat as required. Finally, use the T-BUG E com-

mand to go back to the normal EDTASM and produce final object and source tapes.

You must move T-BUG to a higher than normal memory location because of a fundamental EDTASM and T-BUG conflict. I recommend that you extend T-BUG as described in "T-BUG and Then Some," by M. Paxton (*80 Microcomputing*, November 1980), then move the modified program into high memory. For this, see "Get T-BUG High," by I. Rappaport (*80 Microcomputing*, January 1980). The version of T-EDASM shown in the program listing is for use with the extended form of T-BUG starting at address 7380H.

After you have moved T-BUG, the memory map for the final T-EDASM (for 16K of memory) is as shown in Figure 1. This leaves 6600H–71FFH (a little over 3K bytes) of storage for your new program. By using relative jumps in your program, you can use a new ORG just before making the final tapes to put your program anywhere else in memory.

Hex Memory Locations	Program Portion
42E9–5D40 plus EDTASM text	EDTASM (check end of text with T-BUG)
6600–71FF	Memory for object code (varies with text)
7200–72E4 (7200–72E9 for regular T-BUG)	T-EDASM
7380–797F	Regular T-BUG
7380–7B8A	Extended T-BUG
7B8B–7FFF	EDTASM Table

Figure 1

Type the T-EDASM program listing into EDTASM and record the object code. If you do not use the extended T-BUG, insert the following program lines into the listing in place of line 710:

```
710  CP  'F'       ;REPLACE ORIG T-BUG
712  JP  Z,780DH   ;BYTES
714  JP  73EAH     ;GOTO T-BUG(HIGH)
```

and use regular T-BUG, moved to start at 7380H.

Load T-EDASM, EDTASM and T-BUG (high) and enter T-BUG. Using the M command make the code change in T-BUG and EDTASM shown in Figure 2. The old bytes for T-BUG are for the extended versions. If you are not using this version, the old bytes from 73E5H to 73E9H are FE, 46, CA, 0D, and 78 (hex). Jump (J468A) to EDTASM's cold start and try everything. Load a fresh tape and use T-BUG's P command (P 42E9 7B8A 468A TEDASM) to save the programs. The 7B8A should be 797F if you have the non-extended T-BUG. T-EDASM is now ready with a file name of TEDASM.

If your experimental program crashes, Figure 3 shows a few entry points that may restore operation of T-EDASM. If that does not work,

you have to reload the programs, so make a source code tape every now and then for a long machine language program. If T-BUG hangs up, just press ENTER.

T-BUG

Hex Mem	Old	New
73E5	C3	C3
73E6	06	6C
73E7	7A	72
73E8	00	00
73E9	00	00

EDTASM

Hex Mem	Old	New
4930	00	A0
4931	00	73

Figure 2

Program Portion	Entry (Hex)	Entry (Dec)
EDTASM (cold start)	468A	18058
EDTASM (warm start)	46A2	18082
T-BUG (high)	73A0	29600

Figure 3

Program Commentary

Lines 30-190 contain the program which stores the register-A byte passed from EDTASM (originally to be output to tape) in memory as an object code. The code here is similar to the tape-read portion of T-BUG (low) from 4668H to 469BH. Line 40 is the entry point for the first byte from EDTASM, if no call was made to EDTASM. Lines 200-310 complete EDTASM data passage to memory and reinitiate the first byte entry point. Lines 320-380 contain the first entry point from EDTASM where register A has data, without requiring a call. This portion of the program saves important EDTASM parameters and changes subsequent T-EDASM entry points to RENTRY.

Lines 390-470 save local CALL-RETURN addresses, store T-EDASM important variables, and restore EDTASM parameters. Lines 480-550 save EDTASM variables and retrieve T-EDASM parameters. Lines 560-580 set aside storage space to save T-EDASM parameters. Lines 590-720 are the extension of the T-BUG command input routine to check for A, I, and E commands and jumps as required. The delay prevents key bounce.

Lines 730-830 revise EDTASM to incorporate T-EDASM and assemble to memory. They also modify the prompt to READY TO STORE. Lines 840-940 restore EDTASM to its original configuration, which assembles to tape. They also restore the READY CASSETTE prompt.

The linkage between EDTASM and T-EDASM is accomplished when an EDTASM call statement attempts to pass an assembled byte to a rec-

ord subroutine, and T-EDASM intercepts the byte, decodes the information it contains, and stores the actual object code in memory. T-EDASM then calls (RET) EDTASM for another byte.

Program Listing

```
                     ;TEDASM BY RON ANDERSON
7200                         ORG     7200H
7200 CD4572          DO1     CALL    DATA     ;GO GET A BYTE FROM EDTASM
7203 FE78            ENTRY   CP      78H      ;END OF FILE?
7205 281C                    JR      Z,FIN    ;IF SO GO FINISH
7207 FE3C                    CP      3CH      ;DATA HEADER?
7209 20F5                    JR      NZ,DO1   ;NO SEARCH MORE
720B CD4572                  CALL    DATA     ;YES, GET FIRST BYTE (DATA COUNT)
720E 47                      LD      B,A      ;SAVE DATA COUNT
720F CD4572                  CALL    DATA     ;GET LSB OF LOAD ADDR
7212 5F                      LD      E,A
7213 CD4572                  CALL    DATA     ;GET MSB OF LOAD ADDR
7216 57                      LD      D,A
7217 CD4572          DO2     CALL    DATA     ;GET LINE OF DATA
721A 12                      LD      (DE),A   ;LOAD A BYTE
721B 13                      INC     DE       ;MOVE UP
721C 10F9                    DJNZ    DO2      ;DO TIL DONE
721E CD4572                  CALL    DATA     ;GET CHECKSUM (DON'T USE)
7221 18DD                    JR      DO1      ;START OVER AGAIN
7223 CD4572          FIN     CALL    DATA     ;GET LSB OF ENTRY ADDR
7226 6F                      LD      L,A
7227 CD4572                  CALL    DATA     ;GET MSB OF ENTRY ADDR
722A 67                      LD      H,A
722B 226672                  LD      (STORE1),HL      ;DUMP START ADDR
722E 213972                  LD      HL,FIRENT        ;FIX PROGRAM
7231 228A43                  LD      (438AH),HL       ;    START
7234 F1                      POP     AF       ;FIX EDTASM STUFF
7235 D1                      POP     DE
7236 C1                      POP     BC
7237 E1                      POP     HL
7238 C9                      RET     ;GO BACK TO EDTASM
7239 E5              FIRENT  PUSH    HL       ;SAVE EDTASM STUFF
723A C5                      PUSH    BC
723B D5                      PUSH    DE
723C F5                      PUSH    AF
723D 215672                  LD      HL,RENTRY        ;MODIFY ENTRY PT
7240 228A43                  LD      (438AH),HL       ;  SUBSQ DATA
7243 18BE                    JR      ENTRY    ;PRESS ON
7245 E1              DATA    POP     HL       ;GET LOCAL RET ADDR
7246 226672                  LD      (STORE1),HL      ;SAVE LOCAL RET
7249 ED536872                LD      (STORE2),DE      ;SAVE LOAD INDEX
724D ED436A72                LD      (STORE3),BC      ;SAVE DATA COUNT
7251 F1                      POP     AF
7252 D1                      POP     DE       ;GET STUFF
7253 C1                      POP     BC
7254 E1                      POP     HL
7255 C9                      RET     ;BACK TO EDTASM
7256 E5              RENTRY  PUSH    HL
7257 C5                      PUSH    BC       ;SAVE STUFF
7258 D5                      PUSH    DE
7259 F5                      PUSH    AF
```

```
725A ED5B6872 00520          LD      DE,(STORE2)     ;RECOVER LOAD INDEX
725E ED4B6A72 00530          LD      BC,(STORE3)     ;RECOVER BYTE COUNT
7262 2A6672   00540          LD      HL,(STORE1)     ;RECOVER LOCAL RET
7265 E9       00550          JP      (HL)            ;   AND GOTO IT
0002          00560 STORE1   DEFS    2
0002          00570 STORE2   DEFS    2
0002          00580 STORE3   DEFS    2
726C FE41     00590          CP      'A'     ;CHK FOR EDTASM RETURN
726E 200B     00600          JR      NZ,NEXT ;NO, NEXT INPUT CHK
7270 010050   00610 DEL      LD      BC,5000H        ;YES, DELAY
7273 0B       00620 DO3      DEC     BC      ;    THE
7274 78       00630          LD      A,B     ;        JUMP
7275 B1       00640          OR      C       ;            TO
7276 20FB     00650          JR      NZ,DO3  ;               EDTASM
7278 C3A246   00660          JP      46A2H   ;GOTO EDTASM
727B FE49     00670 NEXT     CP      'I'     ;CHK FOR INTERNAL ASSEMBLY
727D 280C     00680          JR      Z,INT   ;YES,SET-UP FOR INT STORE
727F FE45     00690          CP      'E'     ;CHK FOR EXTERNAL ASSEMBLY
7281 282E     00700          JR      Z,EXT   ;YES, RESTORE INT TO EXT
7283 C3067A   00710          JP      7A06H   ;NO HITS, PRESS ON IN TBUG
0005          00720          DEFS    5       ;ROOM FOR TEDASM ADDITIONS
728B DD21A943 00730 INT      LD      IX,43A9H        ;PREVENT EDTASM
728F DD3600C9 00740          LD      (IX),0C9H       ;  TAPE ON AND SYNC
7293 DD218943 00750          LD      IX,4389H        ;SET-UP JUMP TO
7297 DD3600C3 00760          LD      (IX),0C3H       ;     THE
729B DD360139 00770          LD      (IX+1),39H      ;         NEW
729F DD360272 00780          LD      (IX+2),72H      ;             PROGRAM
72A3 010700   00790          LD      BC,7    ;CHANGE
72A6 21D772   00800          LD      HL,M1   ;  ASSM
72A9 11EA48   00810          LD      DE,48EAH        ;     PROMPT
72AC EDB0     00820          LDIR    ;    MESSAGE
72AE C37072   00830          JP      DEL     ;BACK TO EDTASM
72B1 DD21A943 00840 EXT      LD      IX,43A9H        ;RESTORE TAPE
72B5 DD3600CD 00850          LD      (IX),0CDH       ;    AND SYNC
72B9 DD218943 00860          LD      IX,4389H        ;RESTORE
72BD DD3600E5 00870          LD      (IX),0E5H       ;    ORIGINAL
72C1 DD3601C5 00880          LD      (IX+1),0C5H     ;        EDTASM
72C5 DD3602D5 00890          LD      (IX+2),0D5H     ;            PROGRAM
72C9 010700   00900          LD      BC,7    ;RESTORE
72CC 21DE72   00910          LD      HL,M2   ;  ASSM
72CF 11EA48   00920          LD      DE,48EAH        ;     PROMPT
72D2 EDB0     00930          LDIR    ;    MESSAGE
72D4 C37072   00940          JP      DEL             ;BACK TO EDTASM
72D7 54       00950 M1       DEFM    'TO STOR'
72DE 43       00960 M2       DEFM    'CASSETT'
0000          00970          END
00000 TOTAL ERRORS
```

26

Menu Program for NEWDOS/80 Version 2

by Dr. Walter J. Atkins, Jr.

System Requirements:
Model I
32K RAM
Level II BASIC
One disk drive
NEWDOS/80 Version 2

I have been using Barry Kornfield's disk menu program (*80 Microcomputing*, November 1980, p. 226) on all my game program disks since it appeared. That program, DIRPICK, reads the directory of the disk drive of your choice, numbers the programs, and runs any BASIC or /CMD file by entering its number. Unfortunately, it doesn't work with the latest version of Apparat's NEWDOS/80 operating system. My program is an adaptation of DIRPICK for use on the NEWDOS/80 Version 2.

Because NEWDOS/80 Version 2 is designed to work with double density as well as with single density disk drives, it uses a different format that allows more files to be displayed on the screen at a time. It displays the disk directory in four columns, of fifteen characters each.

I originally just changed line 230 of DIRPICK to accommodate the new format. The original line is L=15488+64*Y+20*Z. The variable Z counts the programs across the screen and the variable Y counts the lines on the screen. I changed the line to L=15488+64*Y+15*Z. I also changed line 200 from FOR Z=0 TO 2 to FOR Z=0 TO 3, but this left the screen too crowded.

I fixed that problem when I noticed that there is no need to display the file extensions when picking a program to run. /CMD and /BAS merely tell the computer whether a file is BASIC or machine language. Without the extensions the maximum length of a file name is eight characters, and the screen display is neater. Line 350 uses the INSTR function to find how many characters there are in the file name preceding the slash (/) used to begin the file extension. It then displays all characters up to the extension.

The original DIRPICK program could display a maximum of 31 programs on the screen. This modified version can display and select from a maximum of 48. If you have more than 48 programs on a disk, this program does not work correctly, because NEWDOS/80 Version 2 then displays the disk directory in pages of up to 48 files each.

If you run a single drive system, you must change line 200 to read 200 CMD"DIR". This reads the directory of the disk on drive 0 rather than the disk on drive 1.

Program Listing

```
1ØØ REM  ****************  MENU8Ø  ********************
11Ø REM   ----- DISK MENU PROGRAM --------
12Ø REM   - ADAPTED FROM 8Ø MICROCOMPUTING NOV 8Ø P226 -
13Ø REM    --- CODED 25 AUG 1981 ---
14Ø REM ===== CODED BY DR. WALTER J. ATKINS ==========
15Ø REM *************************************************
16Ø REM == PROGRAM PURPOSE :  TO PROVIDE A SELECTION
          MENU THAT ALLOWS ANY PROGRAM TO BE SELECTED BY
          NUMBER.
17Ø REM *************************************************
18Ø REM
19Ø CLEAR5ØØ
2ØØ CMD"DIR :1"
21Ø TIT$="AUTOMATIC PROGRAM SELECTION":TL=LEN(TIT$)
22Ø SL=(64-TL)/2:SL=SL-1
23Ø PRINT@Ø,STRING$(SL,"*")+" "+TIT$+" "+STRING$(SL,"*");
24Ø REM
25Ø DIM A$(6Ø)
26Ø FOR Z=Ø TO 3
27Ø L=15488+64*Y+15*Z
28Ø P=P+1
29Ø C=Ø
3ØØ X=PEEK(L+C):IF X<32 THEN X=X+64
31Ø A$(P)=A$(P)+CHR$(X)
32Ø C=C+1
33Ø IF PEEK(L+C)<>32 GOTO 3ØØ
34Ø IF A$(P)=" " GOTO 4ØØ
35Ø ST=Ø:SP=Ø:SP=INSTR("$(P),"/"):IF SP>Ø THEN ST=SP-1 ELSE ST=L
EN(A$(P))
36Ø IF P<1Ø THEN P$=" "+STR$(P) ELSE P$=STR$(P)
37Ø PRINT@(L-15424),CHR$(3Ø);RIGHT$(P$,LEN(P$)-1);". ";LEFT$(A$(
P),ST)+" ";
38Ø NEXT Z
39Ø Y=Y+1:IF Y>12 THEN 4ØØ  ELSE Z=Ø:GOTO 26Ø
4ØØ PRINTCHR$(31);:PRINT@832," "STRING$(63,"*");
41Ø PRINT@896,"     CHOOSE THE PROGRAM YOU WOULD LIKE BY ITS NUM
BER => ";
42Ø IF P>1Ø GOTO46Ø
43Ø X$=INKEY$:IF X$="" GOTO 43Ø
44Ø X=VAL(X$):IF X<1 OR X>P-1 THEN 4ØØ
45Ø GOTO47Ø
46Ø INPUT X:IF X<1 OR X>P-1 THEN 4ØØ
47Ø IF RIGHT$(A$(X),3)="CMD" THEN CMD A$(X) ELSE RUN A$(X)
```

27

TRANSCRIPT

by Brian Cameron

System Requirements:
Model I
48K RAM
Editor/assembler
Cassette or disk Scripsit
RS232 Interface

Before I could save enough money to buy a disk drive for my 32K Model I system, the tape-based version of Scripsit was the most useful program I had. To get the most from my system, I used the tape-based version of Scripsit as an off-line editor, to edit text and transmit it to the IBM computer where I work. This way I could create files even when the IBM was down or the limited phone lines were taken, and transmit later.

The trick was to modify Scripsit to allow a communications program to interface with it. With my program, TRANSCRIPT, you can create a text file, jump into communications mode, sign on to the computer at work, and transmit the formatted text using the Scripsit P,S (print to serial port) command.

TRANSCRIPT modifies the BREAK S (SAVE) command for tape, and the BREAK S,T command for disk. I used S,T for the disk version so you won't be annoyed by a terminal prompt each time you want to save to disk. Although a save to tape for the disk version of Scripsit is rare, it is still supported.

Normally the SAVE command saves the data to tape or disk. Now, when you invoke it, the program asks if you want to save the text via the terminal mode. Reply N, and a normal save is performed. Reply Y, and you are put in terminal mode. The terminal program lets you sign on to a host system and prepare to transmit data. You can send a break signal to the host computer by pressing BREAK, or the up-arrow key if the BREAK key is disabled.

Having established a link with the host computer, you enter the input mode of a system editor, in order to collect and save the data for transmission. Return to TRANSCRIPT by pressing CLEAR. The screen that was saved away is restored and you can send text to the main computer by issuing the P,S command. The cursor stops flashing temporarily while the data is being transmitted. Type BREAK S again to return to the communication mode and close the file on the host computer.

TRANSCRIPT contains a reverse bit routine to convert uppercase characters to lowercase and vice versa before sending the byte to the serial port. (When you type a lowercase letter on the TRS-80, the computer sends it uppercase, and when you press the shift key, it sends it lowercase.) I also modified the Scripsit program to allow a delay after a carriage return is sent. Without the delay, a few bytes get lost at the beginning of the next line.

When I purchased my disk drive, I refined TRANSCRIPT so it would be useful with both disk and tape versions of Scripsit. To use it, you must have 48K of memory in your system.

The program loads at F0000H. Enter the assembly source code into EDTASM and generate an object file. Then load Scripsit into memory without executing it. If you are running a tape version, you must load a monitor program at the address specified in the TRANSCRIPT patch program. Load and execute the patch program. It modifies Scripsit and moves the communications package, sitting at location F0000H, up against Scripsit. Save the memory addresses specified by the program, and you have the modified version of Scripsit I call TRANSCRIPT. It is no longer necessary to load two programs.

When you load and execute TRANSCRIPT, it moves the packed code above F000H. It also protects memory and prevents TRANSCRIPT text from overwriting the communications code. The tape version of Scripsit sits in memory locations 4300H–69C5H. On an NMI (non-maskable interrupt), memory locations 433FH–434BH are destroyed. This would mean that you could execute Scripsit only once without having to reload. To solve this problem I save the code originally at these addresses and restore it at each reset. The packed code is moved back to location F000H only once, and then the LDIR instruction is set to a 00H (NOP) instruction so it will fall through without moving data.

The modifications for the disk version of Scripsit are minor. I make a check of common memory locations, and determine which version is resident, if any, and apply the appropriate changes.

One change I make to the disk version is to alter the return address of the END command. Normally address 6595H contains 0000H which reboots the system. I add a jump to the display routine to clear the screen, and then go to the warm-start address.

Modifying Scripsit

•Load EDTASM
•L D=TRSCRIPT/SRC:1 (The source for the patch is on drive 1 and called TRSCRIPT)
•A/WE (specify TRSCRIPT/CMD:1 to prompt)
•Reset your system.
•LOAD Scripsit (do not execute).
•TRSCRIPT (will execute the patches)
•Reset your system.
•DUMP TRANS/CMD:1 5200H 8000H 5200H

I use the NEWDOS/80 Version 2 disk operating system, and I cannot guarantee the results with any other operating system. You should be able to make any changes necessary for your particular operating system:

In the procedure for the tape version, you must load a monitor program that will allow you to save the modified version to tape after the changes have been made.

•Load EDTASM
•Load the assembly source code
•Change the monitor jump address
•A/WE (write object to tape)
•Load Scripsit
•Load the object patch program
•Load a monitor
•Run the patch program at F000H
•Save the version of TRANSCRIPT

The monitor program I use is CPU80, an extended version of my CP80 monitor program (*80 Microcomputing*, April 1982), with tape I/O routines. I recommend the MON3 monitor, a relocating monitor you can move to location A000H. You can use MON3 at its normal load address 7000H, but you have to change the source-code listing to reflect the new jump address. If you are using T-BUG, relocate it to a higher address (*80 Microcomputing*, January 1980).

Program Listing

```
F000          01200          ORG    0F000H
002B          01300 KEYBRD   EQU    2BH
0000          01400 DISP     EQU    0000H
401E          01500 VIDRAM   EQU    401EH
0060          01600 DELAY    EQU    0060H
000D          01700 CR       EQU    0DH
00FF          01800 TRUE     EQU    0FFH          ;LOGICAL TRUE
0000          01900 FALSE    EQU    00H           ;LOGICAL FALSE
0000          02000 EOM      EQU    00H
```

```
Ø1C9          Ø21ØØ CLEAR    EQU   Ø1C9H
ØØ2B          Ø22ØØ KBD      EQU   2BH              ;KEYBOARD ROUTINE
ØØ33          Ø23ØØ DSP      EQU   33H
ØØE8          Ø24ØØ RESURT   EQU   ØE8H                 ;IN=CONTROL BITS ,OUT=RESET
ØØE9          Ø25ØØ SWITCH   EQU   ØE9H                 ;IN=SWITCH , OUT=BAUD RATE
ØØEA          Ø26ØØ CTRL     EQU   ØEAH             ;RS232 CONTROL
ØØEB          Ø27ØØ DATA     EQU   ØEBH             ;RS232 DATA
4Ø2Ø          Ø28ØØ CURPOS   EQU   4Ø2ØH
              Ø29ØØ ; FIND OUT WHICH VERSION OF SCRIPSIT
              Ø3ØØØ ; IS LOADED AND JUMP TO PROPER ZAP
              Ø31ØØ ; CODE
              Ø32ØØ ;
FØØØ 3AØ252   Ø33ØØ          LD    A,(52Ø2H)        ;GRAB A COMMON ADDRESS
FØØ3 FE98     Ø34ØØ          CP    98H              ;IS IT TAPE VERSION?
FØØ5 CAC3FØ   Ø35ØØ          JP    Z,MOVER          ;YES
FØØ8 FE43     Ø36ØØ          CP    43H              ;IS IT DISK VERSION?
FØØA 2825     Ø37ØØ          JR    Z,DMOVE          ;YES
FØØC 2114FØ   Ø38ØØ          LD    HL,LOADS         ;TELL USER
FØØF CD3DF3   Ø39ØØ          CALL  MSGDSP           ;... SCRIPSIT NOT LOADED
FØ12          Ø4ØØØ LOOP     EQU   $
FØ12 18FE     Ø41ØØ          JR    LOOP             ;BUZZ LOOP
FØ14 53       Ø42ØØ LOADS    DEFM  'SCRIPSIT NOT LOADED - RESET'
FØ2F ØD       Ø43ØØ          DEFB  CR
FØ3Ø ØØ       Ø44ØØ          DEFB  EOM
              Ø45ØØ ; THE FOLLOWING CODE WILL ZAP AND MOVE THE COMMUNICATION
              Ø46ØØ ; PROGRAM INTO PLACE SO IT CAN BE SAVED AWAY ...
              Ø47ØØ ; TO BE EXECUTED AS ONE MODULE LATER
              Ø48ØØ ;
              Ø49ØØ ; DISK VERSION
FØ31          Ø5ØØØ DMOVE    EQU   $
FØ31 3EC3     Ø51ØØ          LD    A,ØC3H           ;JUMP COMMAND
FØ33 32745F   Ø52ØØ          LD    (5F74H),A        ;ZAP IT
FØ36 321266   Ø54ØØ         LD     (6612H),A
FØ39 21Ø6F3   Ø55ØØ          LD    HL,DART
FØ3C 221366   Ø56ØØ         LD     (6613H),HL
FØ3F 214AF3   Ø56Ø1         LD     HL,XDOS
FØ42 229565   Ø5611         LD     (6595H),HL
FØ45 21DCF1   Ø57ØØ         LD     HL,OURS
FØ48 22F966   Ø57Ø1         LD     (66F9H),HL
FØ4B 212F52   Ø59ØØ          LD    HL,522FH         ;JUMP ADDRESS
FØ4E 22755F   Ø6ØØØ          LD    (5F75H),HL       ;ZAP
FØ51 3E21     Ø61ØØ          LD    A,21H            ;LOAD COMMAND
FØ53 326752   Ø62ØØ          LD    (5267H),A        ;ZAP ZAP
FØ56 21FFEF   Ø63ØØ          LD    HL,ØEFFFH        ;GET ADDRESS
FØ59 226852   Ø64ØØ          LD    (5268H),HL       ;ZAP ZAP ZAP
FØ5C Ø122ØØ   Ø65ØØ          LD    BC,DEND-DAME     ;GRAB COUNT
FØ5F 11ØØ52   Ø66ØØ          LD    DE,52ØØH         ;DESTINATION
FØ62 2191FØ   Ø67ØØ          LD    HL,DAME          ;SOURCE
FØ65 EDBØ     Ø68ØØ          LDIR                   ;MOVE IT
FØ67 Ø1B1Ø1   Ø69ØØ          LD    BC,STACK-CHECKX      ;COUNT
FØ6A 11ØØ7D   Ø7ØØØ          LD    DE,7DØØH         ;DESTINATION
FØ6D 21D3F1   Ø71ØØ          LD    HL,CHECKX        ;SOURCE
FØ7Ø EDBØ     Ø72ØØ          LDIR                   ;MOVE IT
FØ72 Ø11ØØØ   Ø73ØØ          LD    BC,16            ;COUNT
FØ75 112F52   Ø74ØØ          LD    DE,522FH         ;DESTINATION
FØ78 21B3FØ   Ø75ØØ          LD    HL,CRCK2         ;SOURCE
FØ7B EDBØ     Ø76ØØ          LDIR                   ;MOVE IT
FØ7D Ø11BØØ   Ø77ØØ          LD    BC,27
FØ8Ø 21B8F1   Ø78ØØ          LD    HL,LOGO
FØ83 11F757   Ø79ØØ          LD    DE,57F7H
FØ86 EDBØ     Ø8ØØØ          LDIR
```

Program continued

```
FØ88 216ØF1     Ø81ØØ          LD     HL,DUND
FØ8B CD3DF3     Ø81Ø2          CALL   MSGDSP
FØ8E C38EFØ     Ø81Ø4 BUZZ     JP     BUZZ
                Ø91ØØ ;
FØ91            Ø92ØØ DAME     EQU    $
FØ91 21FEEF     Ø93ØØ          LD     HL,ØEFFEH       ;PROTECT ...
FØ94 22B14Ø     Ø94ØØ          LD     (4ØB1H),HL      ;TOP OF BASIC
FØ97 22D64Ø     Ø95ØØ          LD     (4ØD6H),HL      ;AND MEMORY SIZE
FØ9A Ø1B1Ø1     Ø96ØØ          LD     BC,STACK-CHECKX       ;COUNT
FØ9D 11D3F1     Ø97ØØ          LD     DE,CHECKX       ;DESTINATION
FØAØ 21ØØ7D     Ø98ØØ          LD     HL,7DØØH        ;SOURCE
FØA3 EDBØ       Ø99ØØ          LDIR                   ;MOVE IT
FØA5 3EØØ       1ØØØØ          LD     A,ØØH
FØA7 321252     1Ø1ØØ          LD     (5212H),A
FØAA 321352     1Ø2ØØ          LD     (5213H),A
FØAD CD1266     1Ø21Ø          CALL   6612H    ;INIT THE UART
FØBØ C33F52     1Ø3ØØ          JP     523FH
FØB3            1Ø4ØØ DEND     EQU    $
                1Ø5ØØ ;
FØB3            1Ø6ØØ CRCK2    EQU    $
FØB3 FEØD       1Ø7ØØ          CP     ØDH             ;IS IT A CR
FØB5 C2785F     1Ø8ØØ          JP     NZ,5F78H        ;NO - RETURN
FØB8 C5         1Ø9ØØ          PUSH   BC              ;SAVE
FØB9 Ø1FFFF     11ØØØ          LD     BC,ØFFFFH       ;AMOUNT OF TIME
FØBC CD6ØØØ     111ØØ          CALL   DELAY           ;WAIT
FØBF C1         112ØØ          POP    BC              ;RESTORE
FØCØ C37C5F     113ØØ          JP     5F7CH           ;RETURN
                114ØØ ; TAPE VERSION
FØC3            115ØØ MOVER    EQU    $
FØC3 3EC3       116ØØ          LD     A,ØC3H          ;JUMP COMMAND
FØC5 32294F     117ØØ          LD     (4F29H),A       ;ZAP IT
FØC8 32AE56     118ØØ          LD     (56AEH),A       ;ZAP THE S COMMAND
FØCB 32EA55     119ØØ          LD     (55EAH),A
FØCE 21EEF2     12ØØØ          LD     HL,TART
FØD1 22EB55     121ØØ          LD     (55EBH),HL
FØD4 21D3F1     122ØØ          LD     HL,CHECKX
FØD7 22AF56     123ØØ          LD     (56AFH),HL
FØDA 212F43     124ØØ          LD     HL,432FH        ;JUMP ADDRESS
FØDD 222A4F     125ØØ          LD     (4F2AH),HL
FØEØ 3E21       126ØØ          LD     A,21H           ;LD COMMAND
FØE2 326443     127ØØ          LD     (4364H),A       ;ZAP IT
FØE5 21FFEF     128ØØ          LD     HL,ØEFFFH       ;GET ADDRESS
FØE8 226543     129ØØ          LD     (4365H),HL      ;ZAP IT
FØEB Ø12DØØ     13ØØØ          LD     BC,SEND-SAME    ;GRAB THE COUNT
FØEE 11ØØ43     131ØØ          LD     DE,43ØØH        ;DESTINATION
FØF1 218BF1     132ØØ          LD     HL,SAME         ;SOURCE
FØF4 EDBØ       133ØØ          LDIR                   ;MOVE IT
FØF6 Ø1B1Ø1     134ØØ          LD     BC,STACK-CHECKX       ;COUNT
FØF9 11ØØ6A     135ØØ          LD     DE,6AØØH        ;DESTINATION
FØFC 21D3F1     136ØØ          LD     HL,CHECKX       ;SOURCE
FØFF EDBØ       137ØØ          LDIR                   ;MOVE IT
F1Ø1 Ø11BØØ     138ØØ          LD     BC,27
F1Ø4 21B8F1     139ØØ          LD     HL,LOGO
F1Ø7 11F448     14ØØØ          LD     DE,48F4H
F1ØA EDBØ       141ØØ          LDIR
F1ØC            142ØØ SAVEM    EQU    $
F1ØC 211BF1     143ØØ          LD     HL,DUNT
F1ØF CD3DF3     1431Ø          CALL   MSGDSP
F112            1432Ø KWT      EQU    $
F112 CD2BØØ     1433Ø          CALL   KBD
F115 B7         1434Ø          OR     A
```

```
F116 28FA     14350          JR      Z,KWT
              14360 ;REPLACE ADDRESS OF NEXT LINE
              14370 ;WITH THE ADDRESS OF YOUR MONITOR
F118 C300A0   14380          JP      0A000H
F11B 53       14600 DUNT     DEFM 'SAVE MEMORY 4300 TO 6C00 FOR TAPE VERSION'
F144 0D       14700          DEFB  CR
F145 50       14800          DEFM 'PRESS ANY KEY TO CONTINUE'
F15E 0D       14900          DEFB  0DH
F15F 00       15000          DEFB  00H
F160 52       15100 DUND     DEFM 'RESET SYSTEM AND DUMP MEMORY 5200 TO 8000'
F189 0D       15200          DEFB  CR
F18A 00       15300          DEFB  00H
F18B          15400 SAME     EQU   $
F18B 21FEEF   15500          LD    HL,0EFFEH       ;PROTECT ...
F18E 22B140   15600          LD    (40B1H),HL      ;TOP OF BASIC
F191 22D640   15700          LD    (40D6H),HL      ;AND MEMORY SIZE
F194 01B101   15800          LD    BC,STACK-CHECKX      ;COUNT
F197 11D3F1   15900          LD    DE,CHECKX       ;DESTINATION
F19A 21006A   16000          LD    HL,6A00H        ;SOURCE
F19D EDB0     16100          LDIR
F19F 011F00   16200          LD    BC,OURE-OURCK   ;LENGTH
F1A2 112F43   16300          LD    DE,432FH        ;DESTINATION
F1A5 211EF3   16400          LD    HL,OURCK        ;SOURCE
F1A8 EDB0     16500          LDIR
F1AA 3E00     16600          LD    A,00H           ;NOP OUT ...
F1AC 321243   16700          LD    (4312H),A       ;THE LDIR
F1AF 321343   16800          LD    (4313H),A       ;INSTRUCTION
F1B2 CDEA55   16810          CALL   55EAH
F1B5 C33F43   16900          JP    433FH
F1B8          17000 SEND     EQU   $
              17100 ;
F1B8 54       17200 LOGO     DEFM 'TRANSCRIPT BY BRIAN CAMERON'
F1D3          17300 CHECKX   EQU   $
F1D3 FE53     17400          CP    'S'             ;IS IT SAVE TAPE?
F1D5 2805     17500          JR    Z,OURS          ;YES - OUR SAVE FIRST
F1D7 F5       17600          PUSH  AF
F1D8 F1       18000          POP   AF              ;RESTORE REG
F1D9 C3B256   18100          JP    56B2H           ;RETURN TO SCRIPSIT
              18500 ;
F1DC          18600 OURS     EQU   $
F1DC F5       18700          PUSH  AF
F1DD C5       18800          PUSH  BC
F1DE D5       18900          PUSH  DE
F1DF E5       19000          PUSH  HL
F1E0 010004   19100          LD    BC,400H         ;GET THE COUNT
F1E3 1100FC   19200          LD    DE,0FC00H       ;POINT TO DEST
F1E6 21003C   19300          LD    HL,3C00H        ;POINT TO SOURCE
F1E9 EDB0     19400          LDIR
F1EB          19800 MDSP     EQU   $
F1EB 2126F2   19900          LD    HL,TERMM        ;GET MESSAGE
F1EE CDC86B   20000          CALL   6BC8H   ;DISPLAY AT BOTTOM
F1F1          20100 MLP1     EQU   $
F1F1 CD2B00   20200          CALL  KBD             ;GET ANSWER
F1F4 B7       20300          OR    A               ;ANYTHING?
F1F5 28FA     20400          JR     Z,MLP1  ;NO RETRY
F1F7 CBAF     20430          RES    5,A     ;INSURE UPPER CASE
F1F9 FE59     20500          CP    'Y'             ;IS IT YES?
F1FB 284B     20600          JR     Z,PRETOP
F1FD FE4E     20700          CP    'N'             ;IS IT NO?
F1FF 20EA     20800          JR    NZ,MDSP         ;INVALID - TRY AGAIN
F201 3E0F     20900          LD    A,0FH           ;TURN CURSOR ...
```

Program continued

```
F203 CD3300   21000          CALL  DSP           ;OFF
F206 010004   21100          LD    BC,400H       ;LENGTH
F209 11003C   21200          LD    DE,3C00H      ;DESTINATION
F20C 2100FC   21300          LD    HL,0FC00H     ;SOURCE
F20F EDB0     21400          LDIR
F211 3AC556   21500          LD    A,(56C5H)     ;GET COMMON BYTE
F214 FECD     21600          CP    0CDH          ;IS IT TAPE?
F216 2807     21700          JR    Z,DISKE
F218 E1       21800          POP   HL
F219 D1       21900          POP   DE
F21A C1       22000          POP   BC
F21B F1       22100          POP   AF
F21C C34F63   22200          JP    634FH
              22300 ;
F21F          22400 DISKE    EQU   $
F21F E1       22500          POP   HL
F220 D1       22600          POP   DE
F221 C1       22700          POP   BC
F222 F1       22800          POP   AF
F223 C3C256   22900          JP    56C2H
              23000 ;
F226          23100 TERMM    EQU   $
F226 20       23110          DEFM  ' '
F227 54       23200          DEFM  'TERM MODE?'
F231 20       23400          DEFM  ' (Y/N)'
F237 20       23410          DEFM  '                 '
F247 00       23600          DEFB  EOM
              23700 ;
F248          23710 PRETOP   EQU   $
F248 CDC901   23720          CALL  1C9H     ;CLEAR AND HOME
F24B 3E0E     23721          LD    A,0EH    ;TURN CURSOR ON
F24D CD3300   23731          CALL  DSP
F250          23800 TOP      EQU   $
F250 CD2B00   23900          CALL  KBD           ;SCAN KEYBOARD
F253 B7       24000          OR    A             ;ANYTHING?
F254 2838     24100          JR    Z,CKIN        ;NO - CHECK INPUT
F256 FE0A     24200          CP    0AH           ;DOWN ARROW?
F258 2834     24300          JR    Z,CKIN        ;YES IGNORE FOR NOW
F25A 214038   24400          LD    HL,3840H      ;GET ROW
F25D CB66     24500          BIT   4,(HL)        ;TEST CONTROL KEY
F25F 2804     24600          JR    Z,NOTCTL      ;NOT DOWN
F261 CBB7     24700          RES   6,A           ;MAKE CONTROL
F263 1824     24800          JR    NBRK          ; SHOW AND TELL
F265          24900 NOTCTL   EQU   $
F265 CDAAF2   25000          CALL  REVBIT        ;REVERSE BITS
F268 FE1F     25100          CP    1FH           ;IS IT A CLEAR?
F26A CAC9F2   25200          JP    Z,EXIT        ;JUMP TO CMD HANDLER
F26D FE01     25210          CP    01H      ;IS IT BREAK
F26F 2804     25220          JR    Z,BREAK ;YES
F271 FE5B     25300          CP    5BH
F273 2014     25400          JR    NZ,NBRK         ;NO - TRANS CHAR
F275          25500 BREAK    EQU   $
F275 3A50F3   25600          LD    A,(CTRLS)     ;GET READY TO BREAK
F278 CB97     25700          RES   2,A               ;TURN ON BREAK
F27A D3EA     25800          OUT   (CTRL),A      ;SEND BREAK
F27C 014A35   25900          LD    BC,354AH      ;SET WAIT TIME
F27F CD6000   26000          CALL  DELAY         ;GO WAIT
F282 3A50F3   26100          LD    A,(CTRLS)     ;TURN OFF BREAK
F285 D3EA     26200          OUT   (CTRL),A      ;SEND RESET
F287 1805     26300          JR    CKIN          ;CHECK FOR INPUT
F289          26400 NBRK     EQU   $
```

```
F289 CD3300   26500          CALL  DSP            ;ECHO
F28C          26600 DSPIT    EQU   $
F28C D3EB     26700          OUT   (DATA),A
              26800 ;
F28E          26900 CKIN     EQU   $
F28E DBEA     27000          IN    A,(CTRL)       ;GET STATUS
F290 CB7F     27100          BIT   7,A            ;ANYTHING WAITING?
F292 CA50F2   27200          JP    Z,TOP          ;NO - RETURN
F295 DBEB     27300          IN    A,(DATA)       ;GET BYTE FROM LINE
F297 FE0A     27400          CP    0AH            ;IS IT A LF?
F299 28F3     27500          JR    Z,CKIN            ;YES - IGNORE
F29B FE7F     27600          CP    7FH            ;IS IT A DEL
F29D 28EF     27700          JR    Z,CKIN            ;YES - IGNORE
F29F FE08     27800          CP    08H            ;IS IT BKSP?
F2A1 2002     27900          JR    NZ,TBELL         ;NO - CONTINUE
F2A3 3E18     28000          LD    A,18H          ;CHANGE TO OUR BKSP
F2A5          28100 TBELL    EQU   $
F2A5 CD3300   28200          CALL  DSP            ;ECHO
F2A8 18E4     28300          JR    CKIN         ;TRY AGAIN
              28400 ;----------------------------------------------
              28500 ;        REVBIT - ROUTINE TO CONVERT
              28600 ;                 UPPER CASE TO LOWER
              28700 ;                 AND LOWER TO UPPER
              28800 ;----------------------------------------------
              28900 ;
F2AA          29000 REVBIT  EQU   $
F2AA FE41     29100          CP    41H            ;CAPS A?
F2AC FAC8F2   29200          JP    M,NOREV
F2AF FE7B     29300          CP    7BH            ;LOW CASE Z?
F2B1 F2C8F2   29400          JP    P,NOREV
F2B4 FE5B     29500          CP    5BH            ;SQUARE BRACKET?
F2B6 2810     29600          JR    Z,NOREV
F2B8 F2BDF2   29700          JP    P,TESTUL
F2BB 1807     29800          JR    REV            ;REVERSE CODE
F2BD          29900 TESTUL   EQU   $
F2BD FE60     30000          CP    60H            ;ACCENT GRAVE
F2BF 2807     30100          JR    Z,NOREV
F2C1 FAC8F2   30200          JP    M,NOREV
F2C4          30300 REV      EQU   $
F2C4 EE20     30400          XOR   20H            ;REVERSE CASE
F2C6 CBAF     30500          RES   5,A            ;CHANGE TO UPPER CASE
F2C8          30600 NOREV    EQU   $
F2C8 C9       30700          RET
F2C9          30800 EXIT     EQU   $
F2C9 3E0F     30900          LD    A,0FH          ;TURN CURSOR OFF
F2CB CD3300   31000          CALL  DSP
F2CE 010004   31100          LD    BC,400H        ;SET COUNT
F2D1 11003C   31200          LD    DE,3C00H       ;POINT TO DESTINATION
F2D4 2100FC   31300          LD    HL,0FC00H
F2D7 EDB0     31400          LDIR
F2D9 3AC556   31500          LD    A,(56C5H)      ;FIND OUT IF TAPE OR DISK
F2DC FECD     31600          CP    0CDH           ;IS IT TAPE?
F2DE 2807     31700          JR    Z,TAPEE        ;NO
F2E0 E1       31800          POP   HL
F2E1 D1       31900          POP   DE
F2E2 C1       32000          POP   BC
F2E3 F1       32100          POP   AF
F2E4 C3BB6F   32200          JP    6FBBH
F2E7          32300 TAPEE    EQU   $
F2E7 E1       32400          POP   HL
F2E8 D1       32500          POP   DE
```

Program continued

```
F2E9 C1        32600           POP   BC
F2EA F1        32700           POP   AF
F2EB C3FA5E    32800           JP    5EFAH
               32900 ;
F2EE           33000 TART      EQU   $
F2EE D3E8      33100           OUT   (RESURT),A
F2F0 DBE9      33110           IN    A,(SWITCH)
F2F2 3251F3    33120           LD    (SWTCHS),A
F2F5 E6F8      33130           AND   0F8H
F2F7 F605      33140           OR    05H
F2F9 3250F3    33150           LD    (CTRLS),A
F2FC D3EA      33160           OUT   (CTRL),A
F2FE 3A51F3    33170           LD    A,(SWTCHS)
F301 E607      33180           AND   07H
F303 C3FE55    33190           JP    55FEH
               33500 ;
F306           33600 DART      EQU   $
F306 D3E8      33610           OUT   (RESURT),A
F308 DBE9      33620           IN    A,(SWITCH)
F30A 3251F3    33630           LD    (SWTCHS),A
F30D E6F8      33640           AND   0F8H
F30F F605      33650           OR    05H
F311 3250F3    33660           LD    (CTRLS),A
F314 D3EA      33670           OUT   (CTRL),A
F316 3A51F3    33680           LD    A,(SWTCHS)
F319 E607      33690           AND   07H
F31B C32666    33700           JP    6626H
               34100 ;
F31E           34200 OURCK     EQU   $
F31E FE0D      34300           CP    0DH            ;IS IT CR?
F320 C22D4F    34400           JP    NZ,4F2DH       ;NO - RETURN
F323 C5        34500           PUSH  BC             ;SAVE REG
F324 01FFFF    34600           LD    BC,0FFFFH      ;AMOUNT OF TIME
F327 CD6000    34700           CALL  DELAY          ;WAIT
F32A C1        34800           POP   BC             ;RESTORE
F32B C3314F    34900           JP    4F31H          ;RETURN
F32E 31FC41    35000           LD    SP,41FCH
F331 3E0A      35100           LD    A,0AH
F333 32E837    35200           LD    (37E8H),A
F336 AF        35300           XOR   A
F337 32A36B    35400           LD    (6BA3H),A
F33A 32A16B    35500           LD    (6BA1H),A
F33D           35600 OURE      EQU   $
F33D           35700 MSGDSP    EQU   $
F33D 7E        35800           LD    A,(HL)
F33E B7        35900           OR    A
F33F 23        36000           INC   HL
F340 CA49F3    36100           JP    Z,LP1
F343 CD3300    36200           CALL  DSP
F346 C33DF3    36300           JP    MSGDSP
F349           36400 LP1       EQU   $
F349 C9        36500           RET
               36600 ;
F34A           36601 XDOS      EQU   $
F34A CDC901    36602           CALL  1C9H      ;CLEAR AND HOME
F34D C32D40    36603           JP    402DH     ;WARM START DOS
               36700 ;
F350 00        36800 CTRLS     DEFB  00H
F351 00        36810 SWTCHS    DEFB  00H
0032           36900           DEFS  50
F384           37000 STACK     EQU   $
F000           37100           END   0F000H
```

28

Tiny Pascal for Disk

by David R. Goben

System Requirements:
Model I
32K RAM
Disk BASIC
NEWDOS/80
One disk drive

Tiny Pascal gives you much of the power of Pascal, at low cost. Radio Shack sells Tiny Pascal for the 16K and 32K Model I. Unfortunately, it's a tape-based version that cannot perform as is from disk. John B. Harrell came to the rescue with alterations so Tiny Pascal can operate on a 32K disk system (*80 Microcomputing*, July 1981). I have modified and expanded Harrell's program to run faster on my 48K Model I, and operate all functions without complicated commands. I have also added printer capability and an option to convert tab characters created in the Pascal editor to three spaces, for easier reading on a program such as Scripsit.

The three BASIC programs in this chapter run unchanged on a NEWDOS/80 system, Versions 1 and 2, for the Model I. If you have another operating system, you must modify the BASIC code. Program Listing 1 is the introductory page; save it under the name INTRO. It runs on DOS boot. Program Listing 2 loads a program to memory, and to a printer if desired, from disk, then runs the Tiny Pascal program. Save it under the name LOAD. Program Listing 3 saves a Pascal program from memory to disk; save it under SAVE.

A user's manual explaining functions and options for the entire package is at the end of this chapter. It includes instructions for developing or editing Pascal programs with Scripsit. The LOAD program accepts Scripsit-created files. The Scripsit program is optional, since Tiny Pascal contains its own text editor. However, Tiny Pascal's editor is line-oriented, simple, and limited. You can use any other word processing program, such as Electric Pencil, or a BASIC program, in place of Scripsit, as long

as it saves the entire text file to disk in ASCII format and concludes with a unique character recognized by LOAD.

LOAD recognizes 0FFH (255), the Tiny Pascal end-of-file marker, and Scripsit's block-end character, 1BH (27). Refer to line 9 of the LOAD listing for the recognition coding. You can use any unique ASCII character, other than 1BH, produced by the word processing program. A 35-track disk easily holds NEWDOS/80, the Tiny Pascal program, three utility programs, and a word processor, such as Scripsit.

The user's manual assumes you have a disk with the following programs loaded on it: NEWDOS/80, PASCAL/CMD (Modified PAS32K), SCRIPSIT/CMD (with patches for NEWDOS/80), and the three BASIC programs, INTRO, LOAD, and SAVE.

Patching PAS32K for PASCAL/CMD

Here's how to modify the tape-based PAS32K program to disk. Novices at NEWDOS/80's LMOFFSET and SUPERZAP programs should be able to use them without any experience. This should be a one-time operation. Have ready a NEWDOS/80 system disk with all visible files except Scripsit and the three BASIC programs removed. These patches use Harrell's Z80 assembly source.

Boot NEWDOS/80 and load LMOFFSET. Load the PAS32K tape to the recorder, set the volume, press PLAY, and type T and press ENTER. When the PAS32K program is loaded, the display shows that the program loads from 4D90–73C6. Type 7000, the new module load address, and press ENTER. Reply Y to the SUPPRESS APPENDAGE? question. You are now told that the module loads from 7000–9636. Answer by pressing ENTER.

If you have Version 2 of NEWDOS/80, you are asked if the destination is disk or tape. Make sure that you have the appropriate disk ready to accept the file, then type D and press ENTER. After the prompt, type PAS-*CAL/CMD:d and press ENTER, where :d is the drive number. If you* have Version 1, reboot DOS. If you have Version 2, type N and press ENTER after the next two prompts.

When the next READY prompt appears, type LOAD PASCAL/CMD and press ENTER. Then type DUMP PASCAL/CMD 7000H 969CH 9637H and press ENTER. After the READY prompt, type SUPERZAP and press ENTER. Type DFS and press ENTER. Type PASCAL/CMD and press ENTER. Type 38 and press ENTER, for the relative sector. When the sector is displayed, type MODD3. When you see the blinking block cursor over location D3, type the following lines:

```
          F3 AF 21 D2 06 11 00 40 01 36 00 ED B0
3D 3D 20  F1 06 27 12 13 10 FC 11 80 40 21 F7 18
01 27 00  ED B0 21 00 70 11 90 4D 01 37 26 ED B0
```

The last two-hex-number entry should force the cursor to location 00. If not, recheck your entries.

When the cursor blinks over location 00, press ENTER and reply Y to the prompt. Press ENTER again, and the modified page is displayed. Press the plus sign (+), and page 39 is displayed. Type MOD00 and press ENTER, and the block cursor appears over location 00.

Type the following patch. When done, the next four hex digits should be 02 02. If not, check your work. Do not type the asterisks (*) surrounding three of the listed entries. If you have a 48K system, change BF to FF, and the two 28s to 68.

21	72	96	11	D5	*BF*	01	2B	00	ED	B0	C3	90	4D	21	00
98	11	F0	73	01	00	*28*	ED	B0	3E	FF	21	F0	73	01	00
28	22	80	41	22	8C	41	ED	B1	22	84	41	22	86	41	22
96	41	2B	22	82	41	C3	3A	47							

When the cursor blinks over the zero in the first 02, press ENTER, answer Y, and press ENTER again when prompted. When page 39 is displayed again, press K. Answer the prompt with 0 and press ENTER. When page 0 is displayed, type MOD10. When the cursor appears, for 32K machines type D5BF and press ENTER, and for 48K machines type D5FF and press ENTER. Answer Y and press ENTER when prompted. When the modified page 0 is displayed, press X to exit the mode, then type EXIT and press ENTER to leave SUPERZAP. To test your work, after the DOS READY prompt, type PASCAL and press ENTER, and Tiny Pascal should be up and running.

Tiny Pascal User's Manual

Here is a detailed list of operating instructions for the disk options of Radio Shack's Tiny Pascal package. Refer to all data related to the Pascal program itself in the *Tiny Pascal User's Manual.*

Running INTRO

When the Pascal disk is booted, an AUTO file, BASIC RUN "INTRO", initializes the system. A menu of seven choices is displayed (see Figure 1).

Option 1 loads the Tiny Pascal program with an empty buffer.

Option 2 loads a Pascal program from disk and runs Pascal.

Option 3 saves a program to disk and reruns INTRO.

Option 4 loads and runs Scripsit.

Option 5 asks which disk directory to read, reads it, and asks you to press ENTER to redisplay the menu.

Option 6 allows you to run DOS command strings from INTRO.

Option 7 leaves INTRO and returns to the DOS command mode.

Running LOAD

To answer yes in LOAD and SAVE, type Y or Yes. To answer no, type N or No or press ENTER.

When you run LOAD, you are asked for the source file's filespec,

then whether the file is resident on a currently mounted disk. If you answer no, you are prompted to mount it. If you have a one disk system, the source program must be on a disk with the same operating system as the Pascal package. If you answer X, the filespec request repeats, which is useful when you enter an erroneous filename. You are next asked if you want to print the file.

If you answer Y when the printer is not ready, you are prompted, and the question is repeated. When the printer is ready, you are asked how many lines long each page is. If your pages hold a maximum of 66 lines, you would type 66 and press ENTER. You are next asked if you want pauses between pages. Last, you are asked if you want data sent to the line printer only. If so, after printing, INTRO runs rather than PASCAL/CMD.

The appropriate PASCAL program is loaded to RAM, and listed one line at a time to the screen (and printer, if specified). After the program is loaded, the Pascal file is run unless you need to mount another disk to load the file. In that case you are prompted to reload the Pascal disk to drive 0. Once you do this and press ENTER, Tiny Pascal loads and runs.

```
** TINY * PASCAL ** Disk Version

Pascal Menu

<1>  PASCAL program without data
<2>  *LOAD a PASCAL source program & run PASCAL
<3>  *SAVE a PASCAL program to disk
<4>  Load SCRIPSIT to edit or create files
<5>  Do a DIRECTORY read with 'A' option
<6>  Do a DOS command
<7>  Exit BASIC to DOS command mode

*Note that you must RE-BOOT DOS (which returns to this program) from PASCAL to
SAVE (or LOAD) a file via disks.

Key in your choice <1-7>?
```

Figure 1. *Screen display of Pascal menu*

Running SAVE

To run SAVE while in Tiny Pascal, reboot DOS, and INTRO reruns. Answer the prompt with option 3. When SAVE is run, you are asked if you want the file printed. If you answer yes, you are asked (as in LOAD) for the page length and whether you want pauses between pages. Next, you are asked if you want the file sent to the line printer only. If you answer yes, skip the next paragraph. A no answer sends the file to the printer, disk, and screen.

If you answered no to the print question, you are asked for the name of the program, then whether the destination disk is currently mounted. If you answer X, the filespec request repeats. If you answer no, you are prompted to load the destination disk. The drive 0 disk must contain the same operating system as the Pascal disk.

You are asked if you want the TAB characters (09H), used in Tiny Pascal's editor, converted to three spaces by the editor's display driver. This option is handy if you want to use Scripsit to edit a program created or edited by Pascal's editor. Otherwise, Scripsit prints each TAB character as a single left arrow. The program is displayed on the screen one line at a time, to show that it is being loaded to disk properly. Once the program is loaded, INTRO reruns.

Line-Print from Tiny Pascal

If you want data that is normally sent to the monitor printed instead, include the two procedures in Figure 2 in your Pascal program. The first diverts video output to the printer driver, and the second resets the video driver to normal.

```
PROC LPRINT; (* DIVERT VIDEO TO PRINTER *)
  BEGIN
    MEMW(%401E):=%058D;
  END;

PROC VIDEO; (* RESET VIDEO OUTPUT TO VIDEO *)
  BEGIN
    MEMW(%401E):=%0458;
  END;
```

Figure 2

Handling Pascal Files with Scripsit

Use uppercase (SHIFT@ command) to type programs if you have the lowercase modification. If you want a blank line separating program blocks, insert a space before pressing ENTER. Tiny Pascal must have data on a line, even if it is only a blank space. Do not include any special Scripsit printer options in the file. Tiny Pascal sees them as illegal entries.

LOAD recognizes Tiny Pascal files, and Scripsit files that meet specifications. Two other points are important. First, the Pascal program ends with an end-block character, followed by a carriage return. When the last line has been typed and entered, press control-block, control-end, ENTER, CLEAR. Second, the file *must* be saved in ASCII format. If you want to load it to a file that Scripsit has called from disk, press BREAK, type S,A and press ENTER. If it is a new file, or you want to change the file name, enter the command mode via BREAK. Then type S,A

and press space and type the filename you want for the Pascal program.

Special Notes

It is a good idea to put a /PAS extension on Pascal filenames, for easy recognition. If you are editing in Scripsit an existing Pascal program which was loaded to disk in the SAVE program, you will note two graphics blocks at the end of the program listing, followed by a Scripsit carriage return character. If you modified the program listing and want to save the newer version to disk, you must delete the three graphics characters and add the end-block and carriage return characters as described earlier.

As an aid in writing the source programs, before keying in data, press BREAK and type T=3,6,9,12,15,18,21, then press ENTER. This allows you to use control-right arrow to tab three spaces at a time.

Program Listing 1. INTRO

```
1   '  I N T R O
2   '
3   POKE &H4ØB1,&HFF:
    POKE &H4ØB2,&H97:
    ON  ERROR  GOTO 27:
    CLS :
    PRINT "** TINY * PASCAL ** Disk version":
    PRINT
4   PRINT  TAB( 8);"Pascal Menu
5   PRINT "<1>         PASCAL program without data
6   PRINT "<2>        *LOAD a PASCAL source program & run PA
    SCAL
7   PRINT "<3>        *SAVE a PASCAL program to disk
8   PRINT "<4>         Load SCRIPSIT to edit or create files
9   PRINT "<5>         Do a DIRECTORY read with 'A' option
1Ø  PRINT "<6>         Do a DOS Command
11  PRINT "<7>         Exit BASIC to DOS Command mode":
    PRINT
12  PRINT "*Note that you must RE-BOOT DOS (which returns t
    o this program)
13  PRINT " from PASCAL to SAVE (or LOAD) a file via disks.
    ":
    PRINT
14  INPUT "Key in your choice <1-7>";CH$
15  IF  VAL (CH$) < 1 OR  VAL (CH$) > 7
       THEN
          PRINT "Wrong choice. Please try again":
             FOR
                X = 1 TO 75Ø:
             NEXT :
          GOTO 3
16  ON  VAL (CH$) GOTO 17,18,19,26,2Ø,28,25
17  CMD "S=PASCAL"
18  RUN "LOAD"
```

```
19  RUN "SAVE"
2Ø  INPUT "Which Drive <Ø-3>";D$
21  IF  VAL (D$) < Ø OR  VAL (D$) > 3
       THEN
          2Ø
22  D$ = "DIR " + D$ + " A":
    CMD "D$"
23  PRINT :
    INPUT "Press ENTER to redisplay Menu";CH$
24  GOTO 3
25  CLS :
    CMD "S"
26  CMD "S=SCRIPSIT"
27  CMD "E":
    FOR
       V = 1 TO 75Ø:
    NEXT :
    RESUME 3
28  CLS :
    LINE  INPUT "Key in Command string: ";ST$:
    IF ST$ = ""
       THEN
          3
       ELSE
    CMD "ST$":
    GOTO 23
```

Program Listing 2. LOAD

```
1  '  L O A D
2  '
3  POKE &H4ØB1,&HFF:
   POKE &H4ØB2,&H97:
   CLS :
   CLEAR 3ØØ:
   DEFINT A - Z:
   AD = &H98ØØ:
   PRINT  TAB( 14)"** TINY * PASCAL ** File Loader":
   PRINT
4  LINE  INPUT "Enter Filespec for Source File: ";FS$:
   IF FS$ = ""
      THEN
         RUN "INTRO"
      ELSE
   A$ = "":
   PRINT "Is Source on a mounted disk (if not, then it mus
   t be on a":
   INPUT "System Disk)";A$:
   IF A$ = "X"
      THEN
         4
      ELSE
   IF  LEFT$ (A$,1) = "N"
      THEN
         INPUT "Mount Source Disk and press ENTER";
5  T$ = "":
   INPUT "Output data to Line Printer";T$:
   IF  LEFT$ (T$,1) = "Y"
```

Program continued

```
      THEN
         IF  PEEK (14312) <  > 63
            THEN
               PRINT "Line Printer NOT ready!":
               PRINT :
               GOTO 5
            ELSE
         INPUT "What is your page leanth";LL:
         IF LL < 7
            THEN
               17
            ELSE
         LL = LL - 6:
         L = LL:
         INPUT "Pause between pages";G$
6   U$ = "":
    IF  LEFT$ (T$,1) = "Y"
       THEN
    PRINT :
    PRINT "Loading *** "FS$" *** from disk":
    IF  LEFT$ (U$,1) = "Y"
       THEN
          PRINT "* Data to Printer ONLY *":
          PRINT
       ELSE
    PRINT
8   L$ = "":
    LINE  INPUT #1,L$:
    IF  LEFT$ (T$,1) = "Y"
       THEN
          LPRINT  TAB( 6);L$:
          L = L - 1:
          IF L = Ø
             THEN
                GOSUB 16:
                GOSUB 15
9   PRINT L$:
    G =  ASC ( LEFT$ (L$,1)):
    IF G = 255 OR G = 27
       THEN
          11
       ELSE
    IF  LEFT$ (U$,1) = "Y"
       THEN
          1Ø
       ELSE
    FOR
       J = 1 TO  LEN (L$):
       POKE AD, ASC ( MID$ (L$,J,1)):
       AD = AD + 1:
    NEXT :
    POKE AD,13:
    AD = AD + 1
1Ø  POKE 143Ø4, PEEK (17161):
    GOTO 8
11  CLOSE :
    POKE AD,255:
    POKE AD + 1,255:
    IF A$ = "N"
       THEN
          INPUT "Mount PACAL Disk and press ENTER";
```

```
12  IF  LEFT$ (T$,1) = "Y"
       THEN
          GOSUB 15:
          IF  LEFT$ (U$,1) = "Y"
             THEN
                RUN "INTRO"
13  CMD "S=PASCAL"
14  CLS :
    CMD "E":
    FOR
       V = 1 TO 75Ø:
    NEXT :
    RESUME 3
15  LPRINT " "; CHR$ (13);" "; CHR$ (13);" "; CHR$ (13):
    RETURN
16  GOSUB 15:
    CLS :
    IF  LEFT$ (G$,1) <  > "Y"
       THEN
          RETURN
       ELSE
    INPUT "Press ENTER to continue";:
    L = LL:
    RETURN
17  PRINT "Illegal entry. Try this part again.":
    FOR
       X = 1 TO 75Ø:
    NEXT :
    GOTO 5
```

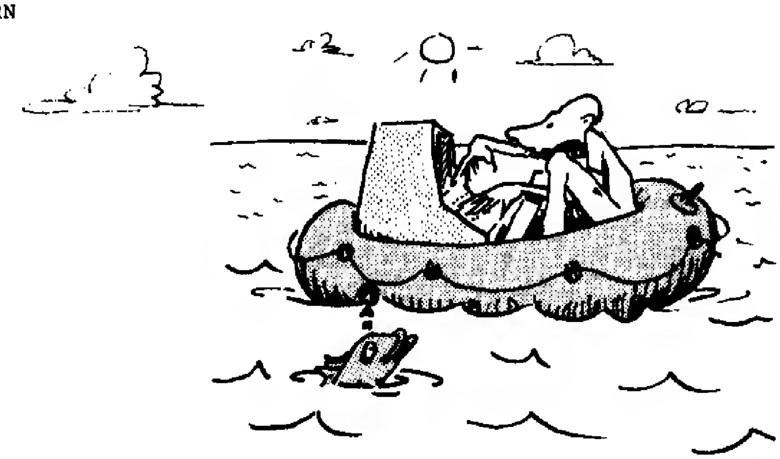
Program Listing 3. SAVE

```
1  '  S A V E
2  '
3  POKE &H4ØB1,&HEF:
   POKE &H4ØB2,&H73:
   CLEAR 3ØØ:
   CLS :
   DEFINT B - Z:
   PRINT  TAB( 16)"** TINY * PASCAL ** File Saver":
   PRINT
4  INPUT "Output data to Line Printer";T$:
   IF  LEFT$ (T$,1) = "Y"
      THEN
         IF  PEEK (14312) <  > 63
            THEN
               PRINT "Line Printer NOT ready!":
               PRINT :
               GOTO 3
            ELSE
         INPUT "What is your page leanth";LL:
         IF LL < 7
            THEN
               4
            ELSE
         LL = LL - 6:
         L = LL:
         INPUT "Pause between Pages";G$
```

Program continued

```
5  IF  LEFT$ (T$,1) = "Y"
      THEN
         INPUT "Data to Line Printer only";U$:
         U$ =  LEFT$ (U$,1)
6  INPUT "Should TABs be converted to 3 SPACES";J$:
   IF  LEFT$ (T$,1) = "Y"
      THEN
         GOSUB 22:
         IF U$ = "Y"
            THEN
               9
7  LINE  INPUT "Enter Filespec for PASCAL File: ";FS$:
   IF FS$ = ""
      THEN
         RUN "INTRO"
      ELSE
   ON  ERROR  GOTO 19:
   R$ = "":
   INPUT "Is Destination Disk mounted on Drive";R$:
   IF  LEFT$ (R$,1) = "N"
      THEN
         GOSUB 2Ø
      ELSE
   IF R$ = "X"
      THEN
         7
8  OPEN "O",1,FS$
9  AD = &H73FØ:
   PRINT :
   IF U$ = "Y"
      THEN
         PRINT "Putting *** "FS$" *** to Printer":
         PRINT
      ELSE
   PRINT "Saving *** "FS$" *** to disk":
   PRINT
1Ø  A$ = ""
11  J =  PEEK (AD):
    IF J = 255
       THEN
          16
       ELSE
    AD = AD + 1:
    IF AD > 32767
       THEN
          AD = AD - 65536
12  IF J = 9
       THEN
          IF  LEFT$ (J$,1) = "Y"
             THEN
                A$ = A$ +  STRING$ (3,32):
                GOTO 11
13  IF J = 13
       THEN
          14
       ELSE
    A$ = A$ +  CHR$ (J):
    GOTO 11
14  IF U$ <  > "Y"
       THEN
          POKE 143Ø4, PEEK (17161):
```

```
        PRINT #1,A$
15  PRINT A$:
    IF  LEFT$ (T$,1) = "Y"
       THEN
          LPRINT A$:
          L = L - 1:
          IF L = Ø
             THEN
                GOSUB 23:
                GOSUB 22:
                GOTO 1Ø
             ELSE
          1Ø
       ELSE
    1Ø
16  IF U$ <  > "Y"
       THEN
          PRINT #1, CHR$ (255); CHR$ (255):
          CLOSE
17  POKE &H4ØB1,&HFF:
    POKE &H4ØB2,&HBF:
    IF  LEFT$ (R$,1) = "N"
       THEN
          GOSUB 21
18  RUN "INTRO"
19  CMD "E":
    CLOSE :
    RESUME 7
2Ø  INPUT "Load Destination System Disk and press ENTER";:
    RETURN
21  INPUT "Load PASCAL Disk and press ENTER";:
    RETURN
22  LPRINT " "; CHR$ (13);" "; CHR$ (13);" "; CHR$ (13):
    RETURN
23  GOSUB 22:
    CLS :
    IF  LEFT$ (G$,1) <  > "Y"
       THEN
          RETURN
       ELSE
    INPUT "Press ENTER to continue";:
    L = LL:
    RETURN
```



29

Faster Loading For the Model I

by Mark E. Tyler

System Requirements:
Model I
16K RAM
Editor/assembler

Get tired of waiting for your Model I to load cassette programs? It's possible to exceed the Model I's 500-baud rate. The programs in this chapter show you how.

The TRS-80 uses the double frequency encoding system for data storage. The timing in this system uses a synchronizing pulse at the start of each bit. The synchronizing pulse is followed by a data pulse if the bit to be read is a 1, or no pulse if the bit to be read is a 0. Figure 1 shows the different ways a 1 and a 0 bit are stored on tape.

The timing is important. The software controlling the reading looks for the synchronizing pulse. Once it's found, the software delays a predetermined amount of time, then looks for the data pulse. If it is there, the bit is considered a 1; if not, a 0. If noise on the tape causes the TRS-80 hardware to think there is a pulse where there is not, an error occurs. By controlling the delay times and the reading times, you can speed up the reading and writing of the tape and improve the reliability of data transfer.

The address of the software for reading a byte of data from the tape is 0235H in the Level II ROM. See Figure 2 for a flow diagram. The code at this location saves the BC and HL registers on the stack and sets up a loop to repeat eight times. The loop repeats eight times because data is read serially—one bit at a time—from the tape. The loop calls the code at 0241H where the actual reading takes place. Once the synchronizing pulse is detected, the data pulse will arrive exactly one millisecond later (assuming a 500-bit baud rate). The timing is accomplished automatically, because the software is written so that the time it takes to execute all the read instructions is one millisecond.

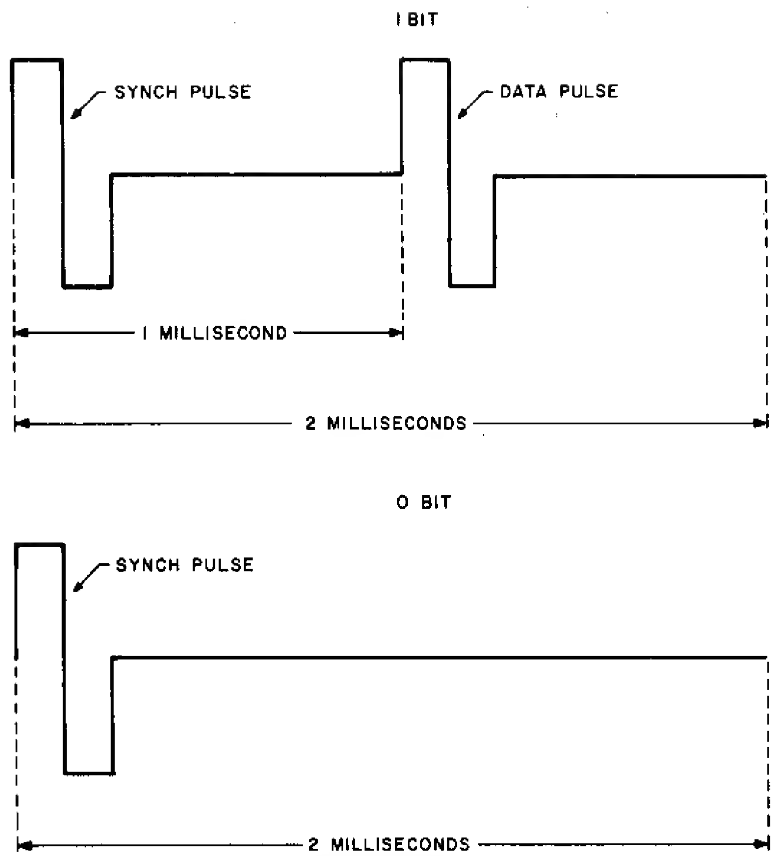


Figure 1. *No data pulse is present if bit is a 0. Timing is for 500 bits/second.*

The Z80 microprocessor used by the TRS-80 requires a definite number of T-states to execute each instruction. A T-state is one clock cycle. In an unmodified TRS-80, a clock cycle is 563 nanoseconds ($5.63 \times 10E\text{-}7$ seconds). The instruction PUSH HL, which requires 11 T-states, would take 11×563, or 6,193, nanoseconds to execute. The complicated instructions are the conditional branches, which require a different number of T-states depending on whether the condition is true or false. For example, the DJNZ instruction requires 13 T-states if B does not equal zero, but only eight if B does equal zero.

Tape reading timing is automatic because the number of T-states has been accounted for by careful selection of the instructions and delay loops in the software. Take the code at 0241H in the ROM. Here the BC and AF registers are saved on the stack, and port 0FFH, the TRS-80's tape port, is checked for synchronizing pulse. Once the pulse is found,

critical timing starts, with a delay loop to use up some T-states. In the later versions of ROM, this loop takes up 1250 T-states. This important loop, DJNZ1, is changed when the tape speed is increased.

Next, the code at 021EH is called. It resets the flip/flop in the TRS-80 tape reading circuit to prepare for the possible 1 pulse from the tape. This code requires 82 T-states. Another delay loop, DJNZ2, is started. It is 1731 T-states long. After this loop, the flip/flop is checked for the presence of a 1-bit pulse. The data, whether it is a 1 or a 0, is stored, and the flip/flop is reset. The program then returns to the code at 0235H. Here the B register is decremented and the whole process repeats until the full eight bits are read.

Remember that DJNZ1 is used to control the length of time between detection of the synchronizing pulse and the resetting of the flip/flop in preparation for the possible data pulse. The flip/flop shouldn't be reset too soon. That causes a long time between resetting and data pulse arrival, and any noise in the interval can set the flip/flop and cause a reading error. DJNZ2's length controls the time between resetting the flip/flop and checking it. Some time must be allowed for the electronics to stabilize, but too much time can cause an error. The two delay loops together

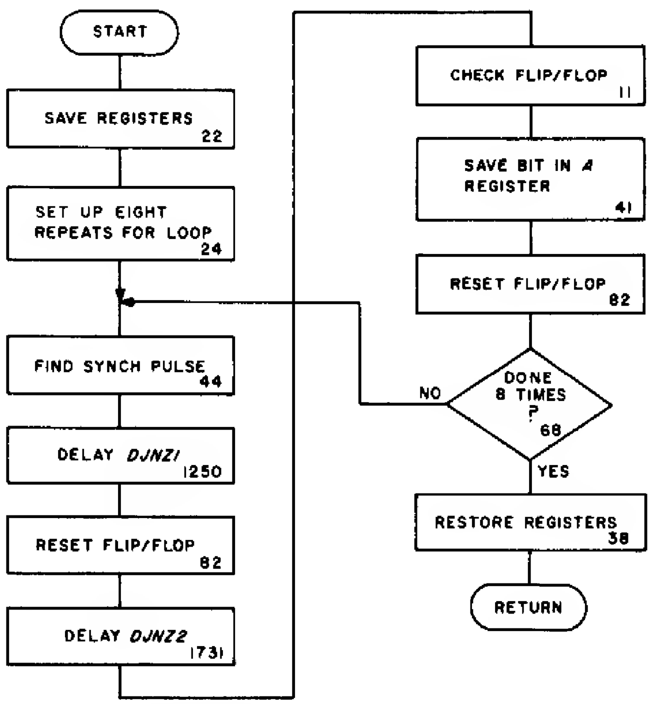


Figure 2. *Tape read subroutine flow chart. Number in bottom right hand corner is number of T-states required to execute the indicated section.*

control how long the software waits after the synchronizing pulse before it looks for a data pulse. Changing these two delay loops is the key to increasing the tape reading speed of the TRS-80.

In order to read a tape faster, it must be written faster. The code for writing a byte to tape is at memory address 0264H. The byte to be written should be in the A register. T-states are important in this code because timing is critical. See Figures 3A and 3B for a flow diagram of the software. First, the registers used by the code are saved. This includes the HL, BC, DE and AF registers. Next, a loop is set up to be executed eight times, and the byte to be written is transferred to the D register.

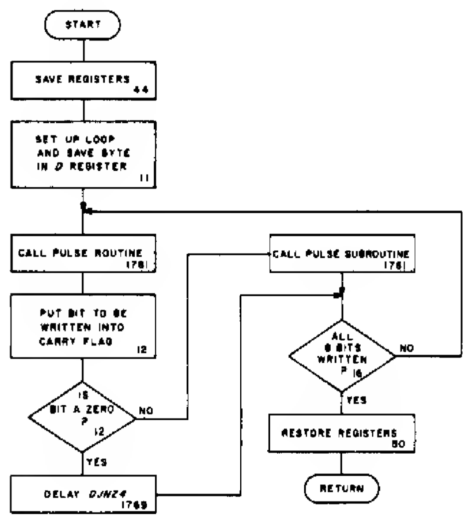


Figure 3A. *Tape write subroutine flow chart. Numbers indicate number of T-states required to execute the indicated section.*

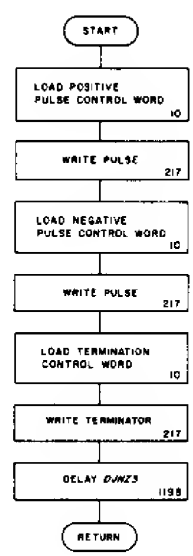


Figure 3B. *Pulse subroutine called from write subroutine*

The code at 01D9H is called. This code writes the synchronizing pulse on the tape. The pulse is really two pulses, one after the other. The first pulse is positive and the second is negative. Each pulse lasts 227 T-states.

The A register is loaded with the byte to be written, from the D register. The A register is then rotated left so the bit to be written is put into the carry flag. The shifted byte is then loaded back into the D register for safekeeping. The bit in the carry flag can be easily tested to see if it is a 1 or a 0. If the carry flag is set (bit is a 1), the code continues by calling 01D9H. If the carry flag is reset (bit is a 0), the code branches to 027EH.

The code at 027EH is a delay loop. It is necessary because if the bit is a 0, no data pulse is written and you have to kill some time. This is done with another DJNZ loop, DJNZ4, which is 1769 T-states long. On completion, control transfers to 0276H. This is the same location the program flow returns to after writing a data pulse, if the carry flag was set. The one data pulse is written with a call to 01D9H, the same code that wrote the synchronizing pulse.

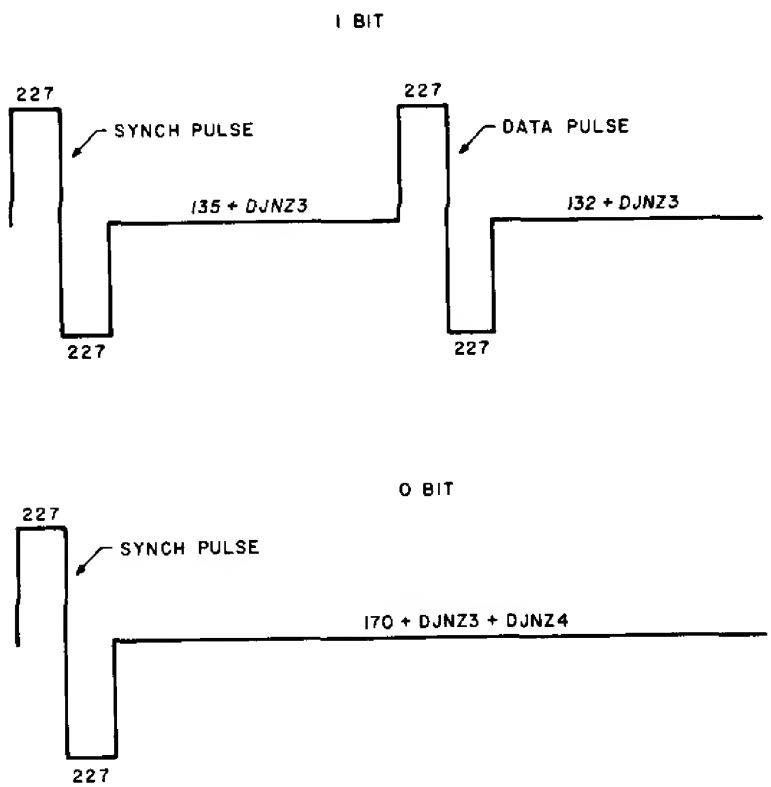


Figure 4. *Software timing measured in T-states*

At 01D9H, a control word is loaded into the HL register and the code at 0221H is called (Figure 3B). This outputs a positive pulse to the tape recorder. The length of the pulse is controlled by a DJNZ loop. Another control word is loaded into the HL register, and the routine at 0221H is called again, but this time a negative pulse is written to the tape. Its length is also controlled by a DNJZ loop. To terminate the negative pulse another control word is loaded into the HL register, and the routine at 0221H is called once more. Finally, another DJNZ loop, DJNZ3, is executed. It is important in controlling the writing time, and is 1198 T-states long. After executing this loop, control transfers back to 0276H.

The C register is decremented and checked to see if all eight bits have been written. If not, control goes back to 026BH, where the synchronization pulse is again written. If all eight bits have been written, the registers pop off the stack, and control returns to the calling routine. Figure 4 is Figure 1 redrawn to show the length of time, measured in T-states, for each part of the stored signal. DJNZ3 alone controls the timing of the 1 bit. You can shorten the delay of DJNZ3 and increase the number of 1 bits you can write per second. The 0 bit is controlled by both DJNZ3 and DJNZ4. It is a simple matter to shorten the length of the 0 bit so you can write faster. Just make sure the 0 bit is about the same length as the 1 bit. They need not have exactly the same length because there is some excess time in the reading code, and the reading timing always starts with the detection of the synchronization pulse.

Figure 5 shows how DJNZ1 and DJNZ2 control the reading time: the positive pulse represents the reading of the TRS-80 tape flip/flop, and the negative pulses represent the resetting of the flip/flop. The figure starts with the detection of the synchronization pulse. The numbers represent the length of time, measured in T-states. By adjusting DJNZ1 and DJNZ2, you can control when the flip/flop is reset and how far into the data pulse you check for the presence of the pulse.

By controlling these four delay loops, you control the tape writing and

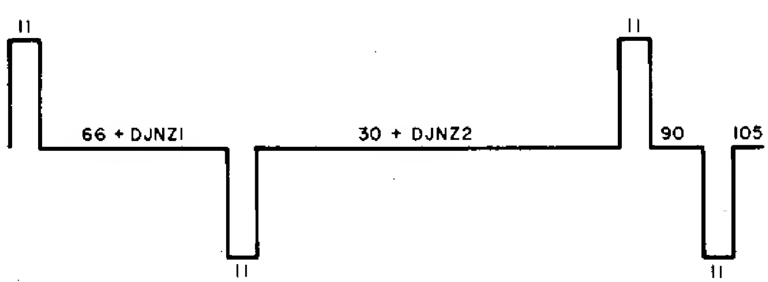


Figure 5. *Positive pulse represents checking status of flip/flop. Negative pulse represents resetting the flip/flop.*

reading speeds. I have done experiments at various speeds of writing and reading that range from the 500 bits/second standard to over 1500 bits/second. Figure 6 is a table of the various delay times, in T-states, for the four DJNZ loops in the reading and writing routines. The control bytes to be loaded into the B register to obtain the necessary delays are in parentheses.

Bits/Sec	Total Pulse Length	DJNZ1	DJNZ2	DJNZ3	DJNZ4
500	3554	1243(60H)	1724(85H)	1191(5CH)	1750(87H)
600	2959	1035(50H)	1412(6DH)	892(45H)	1438(6FH)
700	2540	879(44H)	1204(5DH)	684(35H)	1230(5FH)
800	2228	775(3CH)	035(50H)	528(29H)	1074(53H)
900	1968	671(34H)	918(47H)	398(1FH)	944(49H)
1000	1760	554(2BH)	840(41H)	294(17H)	840(41H)
1100	1604	476(25H)	736(39H)	216(11H)	762(3BH)
1200	1474	424(21H)	684(35H)	151(0CH)	697(36H)
1300	1370	372(1DH)	645(32H)	99(08H)	645(32H)
1400	1266	320(19H)	593(2EH)	47(04H)	593(2EH)
1500	1188	294(17H)	489(26H)	8(01H)	554(2BH)

Figure 6. *Delay time constants for read and write subroutines. Numbers in parentheses are control bytes needed for the delay loops.*

Keep in mind when using modified tape speeds that the speed is for writing the bits of a byte. If you use a 1500 bit/second reading or writing subroutine, it does not control the length of time between bytes. The calling program does that. That is how you can still do all the things between bytes that were done before. You are not really writing everything at the 1500 bits/second rate; if you could see the bits on the tape, you would see groups of eight bits spaced at 0.666 millisecond intervals and the 8-bit groups spaced at some other interval, dependent on the program calling the faster writing subroutine.

If these high-speed routines are to be of any practical value, you must be able to use them to read and write both BASIC and system tapes. You should be able to read in existing tapes at the normal speed and write them again at the higher speed. You can do this with machine-language programs that patch themselves into BASIC ROM, giving you two new commands and a third, modified command. The two new commands are LOAD and SAVE. They operate like CLOAD and CSAVE, but at a higher speed. The third command is a modified SYSTEM command which allows system tapes to be read at normal or faster speed. Another program (Program Listing 4) shows how to modify John Harrell's ZBUG monitor (*80 Microcomputing*, January 1981, p. 130) to read and write tapes at both normal and fast speed.

The first three programs add new commands to ROM. The LOAD and

SAVE commands are already reserved words in the ROM, but are used only on disk systems. If you try to execute the SAVE command without Disk BASIC, you get the L3 ERROR message. This is because Level II BASIC branches to RAM memory location 41A0H after a SAVE command. A jump to the error message routine is placed there during the initialization of this area of RAM from the MEM SIZE message. When Disk BASIC is loaded and initialized, it places new jump instructions at this and other RAM locations that patch into Disk BASIC. You can do the same thing with this program by placing jump instructions to the locations of our new code.

When the ROM encounters the SYSTEM command, a call is made to 41E2H in RAM. Normally there is a RETurn instruction there so program control goes back into ROM. By placing a jump instruction here, you can branch to the new SYSTEM code very easily. The initialization portion of each program sets up all the jumps needed.

Each program is similar to the corresponding program in ROM written by Microsoft, with the new read and write codes patched in. The similarity means the programs operate exactly like the corresponding BASIC command. The start of the code is the initialization portion of the program. Jump instructions are placed into the communications section of RAM at the correct locations for LOAD, SAVE, and SYSTEM.

The first program (see Program Listing 1) is SAVE, which is the high speed equivalent of CSAVE. The first thing that SAVE does is turn on the recorder, by calling a ROM subroutine at 01FEH, which selects the correct recorder and turns it on. Next, it writes 256 zeros to tape followed by the 0A5H marker. A call is made to 2337H in the ROM. This code looks for a file name. The address of the string containing the file name is in the HL register on returning from the subroutine. A call to 2A13H gets the address into the DE register. Next, the three 0D3H leader bytes are written on the tape, followed by the file name whose address is in the DE register.

The DE register is set up to point to the start of the BASIC program. The HL register contains the address of the end of the program. The A register is loaded with the contents of the address in the DE register. The A register is written to tape using the fast writing program. The DE register is incremented and compared with the HL register. This procedure repeats until the end of the BASIC program (HL = DE). The recorder is turned off with a call to 01F8H, the HL and BC registers are restored, and control returns to ROM.

The rest of the SAVE program involves the speeded-up write subroutine. The program defines a word called WRSP, which contains the DJNZ3 and DJNZ4 delay loop variables to be loaded into the B register in order to obtain the desired tape speed. The WRSP variable in Program Listing 1 is for writing at 1000 bits/second. Use Figure 6 to select a speed. DJNZ4 is the most significant byte and DJNZ3 is the least significant byte of

WRSP. To use WRSP, load HL with the address of WRSP, then load B with the contents of the address pointed to by the HL register.

The next program (Program Listing 2) is called LOAD. It loads a fast tape written by SAVE. First, the proper RDSP variable is created. Next, a check is made to see if a question mark (?) follows the LOAD command. If so, the load is being verified as in CLOAD? If it is a LOAD? command, a flag is set and saved. A LOAD command resets the flag before saving it. The file name is searched for, and when found, combined with the LOAD/LOAD? flag and stored in RAM. If this is a LOAD command, the NEW subroutine at 1B4DH is called. The tape recorder is turned on and the tape is read, looking for the synchronizing zeros in the leader. Once these are found, the LOAD/LOAD? flag and the file name to the DE register are restored. The three 0D3H bytes are read from the tape. The file name is read from the tape and compared with the one stored in the E register. If it is not right, a jump is made to LD4 to wait for the right file name to be read.

After the right file name has been found, the tape is read again, looking for the next byte. If the LOAD/LOAD? flag in the D register is set, the byte is compared with the data in memory. If an error occurs, a jump is made to LD2, where the BAD message is displayed, before the return to BASIC at 1A18H. If the byte was the same as in the program or if the LOAD/LOAD? flag is reset, the bit is saved and the free memory pointer is updated with a call to 196CH.

A test is made to see if the byte is a zero. If so, the star in the right hand corner of the screen blinks, and the process starts over, until three zeros are found. When that is accomplished, the READY message appears, the recorder is turned off, and the starting address is saved on the stack before returning to BASIC at 1AE8H. The LOAD routine uses the READ and SYNCH routines following the SYSTEM program. A storage area called RDSP is defined, with the DJNZ1 and DJNZ2 delays already loaded into them. Then the B register is loaded with these delays from the RDSP word. DJNZ2 is the most significant byte of RDSP and DJNZ1 is the least significant byte.

The third program (Program Listing 3) is the SYSTEM code. It functions like the standard SYSTEM command, except that whenever a file name is specified, a short message which says (FAST/SLOW) is displayed. Responding F to this message loads the RDSP word with the faster reading speed variable. Any other response loads the RDSP word with the standard 500 bit/second speed variable. The tape then reads at the selected speed with the same results as the regular SYSTEM command.

The SYSTEM code starts by popping the return address of the calling program off the stack. This keeps the stack in order. Next a jump is made to SYSTM2, to set up a new stack pointer and skip down one line on the video with a call to 20FEH. The system prompt (*?) displays, and execu-

tion waits on input from the keyboard. This input is evaluated and a branch is made if the first character is a slash (/). If it is, a jump is made back into the ROM SYSTEM routine at 031DH. If there was no slash, the input is assumed to be a file name. The SPEED subroutine is called where the (FAST/SLOW) message is displayed, and the input is evaluated so the proper DJNZ delays are loaded into RDSP.

The tape recorder is turned on and the synchronizing byte is looked for. The 55H byte is found next, followed by a search for the correct file name. Once it's found, the star in the top right-hand side of the screen is turned on or off. Another byte is then read and compared to 78H. This is the end of the tape flag and it branches to SYSTM1, where the transfer address is stored in 40DFH, and the recorder is turned off. The stack pointer is readjusted, the system prompt (*?) displays, and the program waits for input.

If the 78H flag is not found, the tape is read until a 3CH is detected. This is followed by the number of bytes to read and the address where the bytes are to be stored. A checksum is set up, and the bytes are read from the tape and stored in the appropriate place. Once all the bytes are ready, the checksum is compared with the one read from tape. If they are different, a C displays in the upper right-hand corner of the screen, and the tape is scanned for the start of the next program. If the checksum is right, the program branches to SYSTM5, to look for the 78H byte and continue from there. The SYSTEM program sequence ends by turning off the tape recorder and displaying the system prompt (*?).

These three programs provide the commands to read and write fast BASIC tapes and to read fast system tapes, but you need a method of writing fast system tapes. The easiest way is to modify a monitor program, as in Program Listing 2. I chose John Harrell's ZBUG program (*80 Microcomputing*, January 1981) for its very good tape copying and verification commands. Modification requires finding all the locations in the monitor where a write-from-tape or read-to-tape function occurs and substituting calls to the new routines. You can use the ZBUG monitor to find these locations. The find address (A) command in ZBUG is loaded with one of the subroutine addresses to be searched for, followed by the area in memory where ZBUG resides. The addresses needed are 0235H(READ), 0264H(WRTAPE), 0287H(WSYNCH), 0214H(RDBIT) and 0296H(SYNCH). Once found, the address portion of the call instructions is changed to point to the appropriate new subroutine patched in at the end of ZBUG. Some editor/assembler programs make the address changing easier because they have a macro command. The EDTASM+ program allows the use of macros. In Program Listing 2, the macro NEW is defined with variables #ADD and #NAME. The macro is simply ORG #ADD, followed by CALL #NAME, and is used 43 times to set up all the necessary patches.

In Program Listing 4, TAPE is the subroutine that prints an F/S message after the selected ZBUG command. It accepts a one letter response. An F response loads the WRSP and RDSP words with the high-speed DJNZ variables. Any other response loads the words with the regular speed variables. The COPY and WRITE subroutines in Program Listing 4 are necessary because these ZBUG commands need slightly different processing than the others.

These programs can also be assembled on an editor/assembler like EDTASM+. Program Listings 1–3 reside in upper memory and are shown at 7E00H for a 16K machine. This is a multiple-origin set of programs. Only the origin indicated in the comments on each program should be changed when relocating the program. Once the programs have been entered and debugged, save them to tape. They can then be loaded under the SYSTEM command. Always load Program Listing 1 last, because there the changes to the RAM addresses for SYSTEM, LOAD and SAVE are made. If Program Listing 1 is loaded before Program Listing 3, the SYSTEM command jumps to the new address, but there is no program there. No initialization of the programs is necessary, so control returns to BASIC with a slash (/) ENTER after the last part is loaded under the SYSTEM command. You have the three new commands in your Level II BASIC until you return to the memory size question, when you must enter the programs again. Be sure to protect sufficient memory (32255) when answering the memory size question.

Program Listing 4 can be entered by using an editor/assembler that supports macros, such as Microsoft's Editor/Assembler+. Once ZBUG (or a similar monitor) has been modified, it can make copies of itself at slow or fast speed. You can use it to read any SYSTEM tape at 500 baud, and write it to tape at a higher speed using the COPY (,) command. Using the 1000 bit/second loading speed can decrease your loading time by more than half.

Cautions

Higher speed tapes are more sensitive to the volume control setting. Usually it must be turned down when you load them. Once the proper setting is found, the tapes load very reliably; however, reliability decreases as speed increases. I believe that the volume control problem could be easily overcome with the addition of a pulse-shaping device such as The Data Dubber from the Peripheral People, or a similar device.

The slow DJNZ delays used in both listings are from the new Level II ROM with its improved tape loading features. Some commercial tapes will not load using these delays. This has been true for system tapes more than BASIC tapes. The easiest way to fix the problem is to use the old delays from the original ROM. This would mean changing DJNZ1 to

41H, and DJNZ2 to 76H. After you have made a copy of the troublesome tape, it can be read more reliably using the new delays already in the programs.

Program Listing 1. *SAVE*

```
                 ;================================
                 ;         LISTING I
                 ;      FSTAPE  VER 1.2
                 ;       BY MARK TYLER
                 ;================================



41AØ                     ORG     41AØH    ;SET UP
41AØ C3ØØ7E              JP      SAVE     ;'SAVE' VERB
4188                     ORG     4188H    ;SET UP
4188 C37E7E              JP      LOAD     ;'LOAD' VERB
41E2                     ORG     41E2H    ;SET UP
41E2 C3117F              JP      SYSTEM   ;'SYSTEM' MODIFICATION





7EØØ             MEMORY  DEFL    7EØØH    ;CHANGE THIS ADDRESS ONLY.
                                          ;TO RELOCATE
ØØØØ             DIS     DEFL    MEMORY-7EØØH
7EØØ                     ORG     MEMORY


                 ;-------------------------------
                 ;               SAVE
                 ;      1ØØØ BIT/SEC VERSION
                 ;-------------------------------



7EØØ CD2D7E      SAVE    CALL    WSYNCH   ;TURN ON CASSETTE
                                          ;AND WRITE HEADER
7EØ3 CD3723              CALL    2337H    ;EVALUATE REST OF
                                          ;'SAVE' COMMAND
7EØ6 C5                  PUSH    BC       ;SAVE REGISTER
7EØ7 E5                  PUSH    HL       ;SAVE ADD OF FILE NAME
7EØ8 CD132A              CALL    2A13H    ;PUT ADD IN 'DE' REGISTER
7EØB 3ED3                LD      A,ØD3H   ;WRITE THE THREE
7EØD Ø6Ø3                LD      B,Ø3     ;LEADER BYTES
7EØF CD3A7E              CALL    WRITE    ;ON TAPE
7E12 1ØFB                DJNZ    $-3
7E14 1A                  LD      A,(DE)   ;FILE NAME TO 'A' REGISTER
7E15 CD3A7E              CALL    WRITE    ;WRITE IT ON TAPE
7E18 2AA44Ø              LD      HL,(4ØA4H)  ;POINTER TO BEGINNING
7E1B EB                  EX      DE,HL    ;OF BASIC PROGRAM TO 'DE'
7E1C 2AF94Ø              LD      HL,(4ØF9H)  ;END OF BASIC PROGRAM
                                          ;POINTER TO 'HL' REGISTER
7E1F 1A                  LD      A,(DE)   ;GET NEXT BYTE
7E2Ø 13                  INC     DE       ;STEP POINTER
```

Program continued

```
7E21 CD3A7E   00520          CALL   WRITE     ;WRITE BYTE TO TAPE
7E24 DF       00530          RST    18H       ;COMPARE 'HL' AND 'DE'
7E25 20F8     00540          JR     NZ,$-6    ;AGAIN IF 'DE'<>'HL'
7E27 CDF801   00550          CALL   01F8H     ;TURN OFF CASSETTE
7E2A E1       00560          POP    HL        ;RESTORE REGISTERS
7E2B C1       00570          POP    BC
7E2C C9       00580          RET              ;GO BACK TO BASIC
              00590
7E2D CDFE01   00600 WSYNCH   CALL   01FEH     ;TURN ON CASSETTE
7E30 06FF     00610          LD     B,0FFH    ;WRITE 255
7E32 AF       00620          XOR    A         ;ZEROES
7E33 CD3A7E   00630          CALL   WRITE     ;TO TAPE
7E36 10FB     00640          DJNZ   $-3       ;DONE YET ?
7E38 3EA5     00650          LD     A,0A5H    ;WRITE SYNCH BYTE FIRST
              00660
7E3A E5       00670 WRITE    PUSH   HL        ;SAVE NEEDED REGISTERS
7E3B C5       00680          PUSH   BC
7E3C D5       00690          PUSH   DE
7E3D F5       00700          PUSH   AF
7E3E 0E08     00710          LD     C,8       ;COUNTER FOR 8 BITS
7E40 57       00720          LD     D,A       ;SAVE BYTE TO BE WRITTEN
7E41 CD5D7E   00730 WR2      CALL   WR5       ;WRITE SYNCH PULSE TO TAPE
7E44 7A       00740          LD     A,D       ;RETURN BYTE TO 'A' REG.
7E45 CB07     00750          RLC    A         ;ROTATE BIT TO BE WRITTEN
              00760                           ;TO CARRY FLAG
7E47 57       00770          LD     D,A       ;SAVE IN 'D' AGAIN
7E48 300B     00780          JR     NC,WR4    ;GO IF BIT IS ZERO
7E4A CD5D7E   00790          CALL   WR5       ;WRITE A ONE BIT
7E4D 0D       00800 WR3      DEC    C         ;ADJUST THE COUNTER
7E4E 20F1     00810          JR     NZ,WR2    ;AGAIN IF 'C'<> 0
7E50 F1       00820          POP    AF        ;RESTORE REGISTERS
7E51 D1       00830          POP    DE
7E52 C1       00840          POP    BC
7E53 E1       00850          POP    HL
7E54 C9       00860          RET              ;RETURN TO CALLING PROGRAM
              00870
7E55 21FD7F   00880 WR4      LD     HL,WRSP+1
7E58 46       00890          LD     B,(HL)    ;GET DJNZ4
7E59 10FE     00900          DJNZ   $         ;DELAY AWHILE
7E5B 18F0     00910          JR     WR3       ;GO BACK TO MAIN PROGRAM
7E5D 2101FC   00920 WR5      LD     HL,0FC01H ;POSITIVE CONTROL WORD
7E60 CD2102   00930          CALL   0221H     ;WRITE POSITIVE PULSE
7E63 060B     00940          LD     B,0BH     ;DELAY
7E65 10FE     00950          DJNZ   $         ;AWHILE
7E67 2102FC   00960          LD     HL,0FC02H ;NEGATIVE CONTROL WORD
7E6A CD2102   00970          CALL   0221H     ;WRITE NEGATIVE PULSE
7E6D 060B     00980          LD     B,0BH     ;DELAY
7E6F 10FE     00990          DJNZ   $         ;AWHILE
7E71 2100FC   01000          LD     HL,0FC00H ;TERMINATOR CONTROL WORD
7E74 CD1102   01010          CALL   0211H     ;WRITE TERMINATOR
7E77 21FC7F   01020          LD     HL,WRSP   ;GET DJNZ3
7E7A 46       01030          LD     B,(HL)
7E7B 10FE     01040          DJNZ   $         ;DELAY AWHILE
7E7D C9       01050          RET              ;RETURN TO CALLING PROGRAM
              01060
              01070
              01080 ;  FSTAPE PROGRAM DEFINITIONS
7E7E          01090 LOAD     EQU    7E7EH+DIS
7F11          01100 SYSTEM   EQU    7F11H+DIS
7FFC          01110 WRSP     EQU    7FFCH+DIS
              01120
1A19          01130          END    1A19H
```

Program Listing 2. *LOAD*

```
                00600 ;*********  FSTAPE  PART 2  VER 1.2      *********
                00605 ;*********        BY MARK TYLER          *********
                00610
                00615
7EØØ            ØØ62Ø MEMORY  DEFL    7EØØH    ;CHANGE ONLY THIS ADDRESS
                ØØ625                          ;TO RELOCATE
                ØØ63Ø
                ØØ635
ØØØØ            ØØ64Ø DIS     DEFL    MEMORY-7EØØH
7E7E            ØØ645         ORG     7E7EH+DIS
                ØØ65Ø
                ØØ655 ;------------------------------
                ØØ66Ø ;               LOAD
                ØØ665 ;      1ØØØ BIT/SEC VERSION
                ØØ67Ø ;------------------------------
                ØØ675
                ØØ68Ø
7E7E E5         ØØ69Ø LOAD    PUSH HL          ;SAVE REGISTER
7E7F 212B41     ØØ695         LD      HL,412BH   ;DJNZ1 AND DJNZ2
7E82 22FE7F     ØØ7ØØ         LD      (RDSP),HL  ;INTO RDSP
7E85 E1         ØØ7Ø5         POP     HL       ;RESTORE REGISTER
7E86 D6B2       ØØ71Ø         SUB     ØB2H     ;TEST FOR LOAD?
7E88 28Ø2       ØØ715         JR      Z,$+4    ;JUMP IF LOAD?
7E8A AF         ØØ72Ø         XOR     A        ;SET UP LOAD FLAG
7E8B Ø12F23     ØØ725         LD      BC,232FH  ;USE 2ND AND 3RD BYTES
                ØØ73Ø                          ;TO CPL AND INC 'HL'
7E8E F5         ØØ735         PUSH    AF       ;SAVE FLAG
7E8F 7E         ØØ74Ø         LD      A,(HL)   ;GET FILE NAME IF THERE
7E9Ø B7         ØØ745         OR      A        ;ZERO 'A' IF NO FILE NAME
7E91 28Ø7       ØØ75Ø         JR      Z,$+9    ;JUMP IF NO FILE NAME
7E93 CD3723     ØØ755         CALL    2337H    ;EVALUATE FILE NAME
7E96 CD132A     ØØ76Ø         CALL    2A13H    ;FILE NAME ADD INTO 'DE'
7E99 1A         ØØ765         LD      A,(DE)   ;PUT FILE NAME
7E9A 6F         ØØ77Ø         LD      L,A      ;INTO 'L' REGISTER
7E9B F1         ØØ775         POP     AF       ;GET BACK LOAD/LOAD? FLAG
7E9C B7         ØØ78Ø         OR      A        ;SET A ACCORDING TO FLAG
7E9D 67         ØØ785         LD      H,A      ;SAVE IN 'H' REGISTER
7E9E 222141     ØØ79Ø         LD      (4121H),HL  ;SAVE IN RAM
7EA1 CC4D1B     ØØ795         CALL    Z,1B4DH ;CALL 'NEW' IF FLAG RESET
7EA4 21ØØØØ     ØØ8ØØ         LD      HL,ØØØØH   ;CASSETTE CONTROL WORD
7EA7 CD8Ø7F     ØØ8Ø5         CALL    SYNCH    ;TURN ON CASSETT AND
                ØØ81Ø                          ;FIND ØA5H BYTE
7EAA 2A2141     ØØ815         LD      HL,(4121H) ;RESTORE LD/LD? FLAG
7EAD EB         ØØ82Ø         EX      DE,HL    ;PUT IN 'DE' REGISTER
7EAE Ø6Ø3       ØØ825 LD3     LD      B,Ø3H    ;SET UP LOOP
7EBØ CD967F     ØØ83Ø         CALL    READ     ;TO LOOK FOR THREE
7EB3 D6D3       ØØ835         SUB     ØD3H     ;ØD3H BYTES
7EB5 2ØF7       ØØ84Ø         JR      NZ,LD3   ;JUMP IF NOT ØD3H
7EB7 1ØF7       ØØ845         DJNZ    $-7      ;DO UNTIL FOUND
7EB9 CD967F     ØØ85Ø         CALL    READ     ;READ FILE NAME
7EBC 1C         ØØ855         INC     E        ;USER SPECIFIED NAME?
7EBD 1D         ØØ86Ø         DEC     E        ;SET FLAG IF NAME EXIST
7EBE 28Ø3       ØØ865         JR      Z,$+5    ;JUMP IF NO FILE NAME
7ECØ BB         ØØ87Ø         CP      E        ;COMPARE TO CALLER'S NAME
7EC1 2Ø37       ØØ875         JR      NZ,LD4   ;WAIT UNTIL NAME IS FOUND
7EC3 2AA44Ø     ØØ88Ø         LD      HL,(4ØA4H)  ;BASIC PROGRAM POINTER
                ØØ885                          ; TO 'HL' REGISTER
7EC6 Ø6Ø3       ØØ89Ø         LD      B,Ø3H    ;NEED THREE ZEROES FOR
                ØØ895                          ;END OF FILE
```

Program continued

```
7ECB CD967F     ØØ9ØØ LD1     CALL    READ      ;READ A BYTE
7ECB 5F         ØØ9Ø5         LD      E,A       ;SAVE IN 'E' REGISTER
7ECC 96         ØØ91Ø         SUB     (HL)      ;COMPARE WITH PROGRAM
7ECD A2         ØØ915         AND     D         ; AND WITH LOAD/LOAD? FLAG
7ECE 2021       ØØ92Ø         JR      NZ,LD2    ;PRINT ERROR MESSAGE
                ØØ925                           ;IF MISMATCH
7EDØ 73         ØØ93Ø         LD      (HL),E    ;OTHERWISE SAVE BYTE
7ED1 CD6C19     ØØ935         CALL    196CH     ;ADJUST FREE MEMORY PT.
7ED4 7E         ØØ94Ø         LD      A,(HL)    ;TEST BIT
7ED5 B7         ØØ945         OR      A         ;FOR A ZERO
7ED6 23         ØØ95Ø         INC     HL        ;ADJUST 'HL'
7ED7 2ØED       ØØ955         JR      NZ,$-17   ;LOOP IF NOT ZERO
7ED9 CD2CØ2     ØØ96Ø         CALL    Ø22CH     ;BLINK '*'
7EDC 1ØEA       ØØ965         DJNZ    LD1       ;NEED THREE ZEROES
7EDE 22F94Ø     ØØ97Ø         LD      (4ØF9H),HL  ;SAVE END OF PROGRAM
                ØØ975                           ;ADDRESS IN RAM
7EE1 212919     ØØ98Ø         LD      HL,1929H    ;'READY' MESSAGE ADD
7EE4 CDA728     ØØ985         CALL    28A7H     ;DISPLAY MESSAGE
7EE7 CDF8Ø1     ØØ99Ø         CALL    Ø1F8H     ;TURN OFF CASSETTE
7EEA 2AA44Ø     ØØ995         LD      HL,(4ØA4H)  ;STARTING ADD OF
7EED E5         Ø1ØØØ         PUSH    HL        ;PROGRAM TO STACK
7EEE C3E81A     Ø1ØØ5         JP      1AE8H     ;RETURN TO BASIC
                Ø1Ø1Ø
7EF1 21ØC7F     Ø1Ø15 LD2     LD      HL,MSG1   ;'HL'=ERROR MESSAGE ADD
7EF4 CDA728     Ø1Ø2Ø         CALL    28A7H     ;DISPLAY MESSAGE
7EF7 C3181A     Ø1Ø25         JP      1A18H     ;RETURN TO BASIC
7EFA 323E3C     Ø1Ø3Ø LD4     LD      (3C3EH),A   ;SAVE FILE NAME
7EFD Ø6Ø3       Ø1Ø35 LD5     LD      B,Ø3H     ;SEARCH FOR
7EFF CD967F     Ø1Ø4Ø LD6     CALL    READ      ;THREE ZEROES
7FØ2 B7         Ø1Ø45         OR      A         ;DO UNTIL
7FØ3 2ØF8       Ø1Ø5Ø         JR      NZ,LD5    ;YOU FIND
7FØ5 1ØF8       Ø1Ø55         DJNZ    LD6       ;THREE IN A ROW
7FØ7 CD837F     Ø1Ø6Ø         CALL    SYNCH+3   ;START READING TAPE AGAIN
7FØA 18A2       Ø1Ø65         JR      LD3       ;CONTINUE
                Ø1Ø7Ø
7FØC 42         Ø1Ø75 MSG1    DEFM    'BAD'     ;ERROR MESSAGE
7FØF ØD         Ø1Ø8Ø         DEFB    ØDH
7F1Ø ØØ         Ø1Ø85         DEFB    ØØH
                Ø1Ø9Ø
                Ø1Ø95
                Ø11ØØ ;   FSTAPE PROGRAM DEFINITIONS
7FFE            Ø11Ø5 RDSP    EQU     7FFEH+DIS
7F8Ø            Ø111Ø SYNCH   EQU     7F8ØH+DIS
7F96            Ø1115 READ    EQU     7F96H+DIS
                Ø112Ø
                Ø1125
1A19            Ø113Ø         END     1A19H
```

Program Listing 3. *SYSTEM*

```
                Ø12ØØ ;*********  FSTAPE    PART 3   VER 1.2    *********
                Ø12Ø5 ;*********            BY MARK TYLER        *********
                Ø121Ø
7EØØ            Ø1215 MEMORY  DEFL    7EØØH     ;CHANGE THIS ADDRESS ONLY
                Ø122Ø                           ;TO RELOCATE
                Ø1225
ØØØØ            Ø123Ø DIS     DEFL    MEMORY-7EØØH
7F11            Ø1235         ORG     7F11H+DIS
```

```
                  Ø124Ø
                  Ø1245 ;------------------------------
                  Ø125Ø ;               SYSTEM
                  Ø1255 ;       1ØØØ BIT/SEC VERSION
                  Ø126Ø ;------------------------------
                  Ø1265
                  Ø127Ø
7F11 E1           Ø1275 SYSTEM  POP     HL      ;KEEP STACK IN ORDER
7F12 18Ø9         Ø128Ø         JR      SYSTM2  ;CONTINUE
7F14 CDE77F       Ø1285 SYSTM1  CALL    RDHL    ;GET TRANSFER ADD
7F17 22DF4Ø       Ø129Ø         LD      (4ØDFH),HL  ;SAVE IN RAM
7F1A CDF8Ø1       Ø1295         CALL    Ø1F8H   ;TURN OFF TAPE
7F1D 318842       Ø13ØØ SYSTM2  LD      SP,4288H  ;SET UP NEW STACK
7F2Ø CDFE2Ø       Ø13Ø5         CALL    2ØFEH   ;SKIP DOWN ONE LINE
7F23 3E2A         Ø131Ø         LD      A,2AH   ;'*' TO A REGISTER
7F25 CD2AØ3       Ø1315         CALL    Ø32AH   ;DISPLAY STAR
7F28 CDB31B       Ø132Ø         CALL    1BB3H   ;WAIT ON INPUT
7F2B DACCØ6       Ø1325         JP      C,Ø6CCH  ;JUMP IF BREAK KEY
7F2E D7           Ø133Ø         RST     1ØH     ;LOOK FOR '/'
7F2F CA9719       Ø1335         JP      Z,1997H  ;JUMP TO SN ERROR
7F32 FE2F         Ø134Ø         CP      2FH     ;COMPARE TO '/'
7F34 CA1DØ3       Ø1345         JP      Z,Ø31DH ;JUMP BACK TO RAM IF '/'
7F37 CDC67F       Ø135Ø         CALL    SPEED   ;GET SPEED WANTED
7F3A CD8Ø7F       Ø1355         CALL    SYNCH   ;START CASSETTE AND
                  Ø136Ø                         ;FIND ØA5H BYTE
7F3D CD967F       Ø1365 SYSTM3  CALL    READ    ;READ NEXT BYTE
7F4Ø FE55         Ø137Ø         CP      55H     ;LOOK FOR 55H BYTE
7F42 2ØF9         Ø1375         JR      NZ,SYSTM3  ;DO UNTIL YOU FIND IT
7F44 Ø6Ø6         Ø138Ø         LD      B,Ø6H   ;LOOK FOR
7F46 7E           Ø1385 SYSTM4  LD      A,(HL)  ;6 LETTER
7F47 B7           Ø139Ø         OR      A       ;FILE NAME
7F48 28Ø9         Ø1395         JR      Z,SYSTM5  ;POINTED TO
7F4A CD967F       Ø14ØØ         CALL    READ    ;BY 'HL' REGISTER
7F4D BE           Ø14Ø5         CP      (HL)    ;AND COMPARE
7F4E 2ØED         Ø141Ø         JR      NZ,SYSTM3  ;JUMP IF NOT THE SAME
7F5Ø 23           Ø1415         INC     HL      ;DO UNTIL
7F51 1ØF3         Ø142Ø         DJNZ    SYSTM4  ;MATCH IS MADE
7F53 CD2CØ2       Ø1425 SYSTM5  CALL    Ø22CH   ;BLINK '*'
7F56 CD967F       Ø143Ø SYSTM6  CALL    READ    ;READ NEXT BYTE
7F59 FE78         Ø1435         CP      78H     ;COMPARE WITH 78H
7F5B 28B7         Ø144Ø         JR      Z,SYSTM1;JUMP IF MATCH
7F5D FE3C         Ø1445         CP      3CH     ;COMPARE WITH 3CH
7F5F 2ØF5         Ø145Ø         JR      NZ,SYSTM6  ;DO UNTIL 3CH OR
                  Ø1455                         ;78H FOUND
7F61 CD967F       Ø146Ø         CALL    READ    ;GET # OF BYTES TO LOAD
7F64 47           Ø1465         LD      B,A     ;SAVE IN 'B' REGISTER
7F65 CDE77F       Ø147Ø         CALL    RDHL    ;READ NEXT 2 BYTES AND
                  Ø1475                         ;PUT INTO 'HL' REGISTER
7F68 85           Ø148Ø         ADD     A,L     ;START CHECK SUM
7F69 4F           Ø1485         LD      C,A
                  Ø149Ø
7F6A CD967F       Ø1495 SYSTM7  CALL    READ    ;READ NEXT BYTE
7F6D 77           Ø15ØØ         LD      (HL),A  ;STORE IT
7F6E 23           Ø15Ø5         INC     HL      ;ADJUST STORAGE ADD
7F6F 81           Ø151Ø         ADD     A,C     ;USE FOR CHECK SUM
7F7Ø 4F           Ø1515         LD      C,A     ;SAVE NEW CHECK SUM
7F71 1ØF7         Ø152Ø         DJNZ    SYSTM7  ;ARE ALL BYTES READ?
7F73 CD967F       Ø1525         CALL    READ    ;READ CHECK SUM
7F76 B9           Ø153Ø         CP      C       ;COMPARE WITH OUR'S
7F77 28DA         Ø1535         JR      Z,SYSTM5  ;GO IF MATCH
7F79 3E43         Ø154Ø         LD      A,43H   ;LOAD A WITH 'C'
```

Program continued

```
7F7B 32003D   01545          LD      (3D00H),A   ;AND DISPLAY
7F7E 18D6     01550          JR      SYSTM6  ;CONTINUE
              01555
7F80 CDFE01   01560 SYNCH    CALL    1FEH    ;TURN ON CASSETTE
7F83 E5       01565          PUSH    HL      ;SAVE 'HL'
7F84 AF       01570          XOR     A       ;LOAD A WITH '0'
7F85 CDA27F   01575          CALL    RDBIT   ;READ FROM TAPE
7F88 FEA5     01580          CP      0A5H    ;IS IT 0A5H BYTE?
7F8A 20F9     01585          JR      NZ,$-5  ;NO -- KEEP TRYING
7F8C 3E2A     01590          LD      A,2AH   ;'*' TO A REGISTER
7F8E 323E3C   01595          LD      (3C3EH),A   ;AND DISPLAY
7F91 323F3C   01600          LD      (3C3FH),A   ;ON VIDEO
7F94 E1       01605          POP     HL      ;RESTORE 'HL'
7F95 C9       01610          RET             ;RETURN TO CALLER
              01615
7F96 C5       01620 READ     PUSH    BC      ;SAVE REGISTERS
7F97 E5       01625          PUSH    HL      ;USED
7F98 0608     01630          LD      B,8     ;READ 8 BITS PER BYTE
7F9A CDA27F   01635          CALL    RDBIT   ;READ ONE BIT FROM TAPE
7F9D 10FB     01640          DJNZ    $-3     ;READ ALL EIGHT BITS
7F9F E1       01645          POP     HL      ;RESTORE
7FA0 C1       01650          POP     BC      ;REGISTERS
7FA1 C9       01655          RET             ;RETURN TO CALLER
              01660
7FA2 C5       01665 RDBIT    PUSH    BC      ;SAVE NEEDED
7FA3 F5       01670          PUSH    AF      ;REGISTERS
7FA4 DBFF     01675          IN      A,(0FFH)   ;LOOK FOR
7FA6 17       01680          RLA             ;SYNCH PULSE
7FA7 30FB     01685          JR      NC,$-3  ;DO UNTIL FOUND
7FA9 21FE7F   01690          LD      HL,RDSP ;GET DJNZ1
7FAC 46       01695          LD      B,(HL)  ;AND USE IT
7FAD 10FE     01700          DJNZ    $       ;FOR A DELAY
7FAF CD1E02   01705          CALL    21EH    ;RESET FLIP/FLOP
7FB2 21FF7F   01710          LD      HL,RDSP+1   ;GET DJNZ2
7FB5 46       01715          LD      B,(HL)  ;AND USE IT
7FB6 10FE     01720          DJNZ    $       ;FOR A DELAY
7FB8 DBFF     01725          IN      A,(0FFH)   ;CHECK FLIP/FLOP
7FBA 47       01730          LD      B,A     ;SAVE IN 'B'
7FBB F1       01735          POP     AF      ;AND ON STACK
7FBC CB10     01740          RL      B       ;CHECK TO SEE IF
7FBE 17       01745          RLA             ;PULSE WAS FOUND
7FBF F5       01750          PUSH    AF      ;SAVE ON STACK
7FC0 CD1E02   01755          CALL    21EH    ;RESET FLIP/FLOP
7FC3 F1       01760          POP     AF      ;RESTORE
7FC4 C1       01765          POP     BC      ;REGISTERS
7FC5 C9       01770          RET             ;RETURN TO CALLER
              01775
7FC6 E5       01780 SPEED    PUSH    HL      ;SAVE 'HL'
7FC7 21F07F   01785          LD      HL,MSG2 ;DISPLAY
7FCA CDA728   01790          CALL    28A7H   ;PROMPT
7FCD CD4900   01795          CALL    049H    ;WAIT ON KEYBOARD INPUT
7FD0 FE46     01800          CP      'F'     ;COMPARE WITH 'F'
7FD2 2808     01805          JR      Z,FAST  ;GO IF MATCH
7FD4 216085   01810          LD      HL,8560H   ;SLOW RDSP
7FD7 22FE7F   01815          LD      (RDSP),HL  ;VARIABLE
7FDA 1806     01820          JR      PT1     ;CONTINUE
7FDC 212B41   01825 FAST     LD      HL,412BH   ;FAST RDSP
7FDF 22FE7F   01830          LD      (RDSP),HL  ;VARIABLE
7FE2 CDFE20   01835 PT1      CALL    20FEH   ;SKIP DOWN ONE LINE
7FE5 E1       01840          POP     HL      ;RESTORE 'HL'
7FE6 C9       01845          RET             ;RETURN TO CALLER
```

```
                01850
7FE7 CD967F     01855 RDHL    CALL    READ      ;READ NEXT BYTE
7FEA 6F         01860         LD      L,A       ;STORE IN 'L'
7FEB CD967F     01865         CALL    READ      ;READ NEXT BYTE
7FEE 67         01870         LD      H,A       ;STORE IN 'H'
7FEF C9         01875         RET               ;RETURN TO CALLER
                01880
7FF0 28         01885 MSG2    DEFM    '(FAST/SLOW)"'
                01890
7FFC 1741       01895 WRSP    DEFW    4117H     ;1000 BITS PER SECOND
                01900                           ;DJNZ4 AND DJNZ3
7FFE 2B41       01905 RDSP    DEFW    412BH     ;1000 BITS PER SECOND
                01910                           ;DJNZ2 AND DJNZ1
                01915
1A19            01920         END     1A19H
```

Program Listing 4. *ZBUG Modification*

```
00010 ;==================================
00020 ;              LISTING 4
00030 ;       ZBUG MODIFICATION  VER.1.2
00040 ;          1000 BITS PER SECOND
00050 ;             BY MARK TYLER
00060 ;==================================
00070
00080 ; ----->  REQUIRES EDTASM THAT SUPPORTS
00085 ; ----->  MACROs (such as EDTASM+)
00087 ; ----------------------------------
00090
00100 ;       SET UP MACRO TO CHANGE
00110 ;       CALLS TO ROM
00120
00130
00140 NEW     MACRO   #ADD,#NAME
00150          ORG    #ADD
00160         CALL    #NAME
00170         ENDM
00180         NEW     4543H,TAPE
00190         NEW     459FH,WRITE
00200         NEW     4653H,TAPE
00210         NEW     4751H,TAPE
00220         NEW     47C9H,COPY
00230         NEW     45CCH,WSYNCH
00240         NEW     47DFH,WSYNCH
00250         NEW     454AH,SYNCH
00260         NEW     4663H,SYNCH
00270         NEW     4761H,SYNCH
00280         NEW     45D1H,WRTAPE
00290         NEW     45DAH,WRTAPE
00300         NEW     45EEH,WRTAPE
00310         NEW     45F3H,WRTAPE
00320         NEW     45F7H,WRTAPE
00330         NEW     45FBH,WRTAPE
00340         NEW     4601H,WRTAPE
00350         NEW     460AH,WRTAPE
00360         NEW     4618H,WRTAPE
00370         NEW     461CH,WRTAPE
00380         NEW     4620H,WRTAPE
```

Program continued

```
        NEW     4624H,WRTAPE
        NEW     462AH,WRTAPE
        NEW     4633H,WRTAPE
        NEW     4638H,WRTAPE
        NEW     463FH,WRTAPE
        NEW     4643H,WRTAPE
        NEW     47F6H,WRTAPE
        NEW     4550H,READ
        NEW     4557H,READ
        NEW     4562H,READ
        NEW     456CH,READ
        NEW     4573H,READ
        NEW     457CH,READ
        NEW     466AH,READ
        NEW     4674H,READ
        NEW     467FH,READ
        NEW     4689H,READ
        NEW     469EH,READ
        NEW     46A5H,READ
        NEW     480FH,READ
        NEW     484EH,READ
        NEW     4852H,READ


WRCMD   EQU     4AA8H   ;THESE ARE THE
GETCH   EQU     0049H   ;ADDRESSES NEEDED
OUTSTR  EQU     28A7H   ;FOR SUBROUTINE CALLS
SETUP2  EQU     4A9EH   ;TO ROM OR ZBUG

        ORG     4F20H   ;STORE OUR PATCHES
                        ;STARTING HERE

WSYNCH  LD      B,0FFH  ;SET UP LOOP
        XOR     A       ;TO WRITE 256
        CALL    WRTAPE  ;0'S TO TAPE
        DJNZ    $-3     ;FOLLOWED BY
        LD      A,0A5H  ;0A5H BYTE
WRTAPE  PUSH    HL      ;SAVE NEEDED
        PUSH    BC      ;REGISTERS
        PUSH    DE      ;THEN SET UP
        PUSH    AF      ;TO WRITE
        LD      C,8     ;8 BITS PER BYTE
        LD      D,A     ;STORE BYTE TO BE
                        ;WRITTEN IN 'A'
LP2     CALL    PULSE   ;WRITE SYNCH PULSE
        LD      A,D     ;RESTORE BYTE TO BE
                        ;WRITTEN TO 'A'
        RLCA            ;ROTATE BIT TO BE WRITTEN
                        ;TO CARRY FLAG
        LD      D,A     ;SAVE ROTATED BYTE IN 'D'
        JR      NC,LP4  ;JUMP IF CARRY FLAG RESET
        CALL    PULSE   ;WRITE DATA PULSE
LP3     DEC     C       ;HAVE WE WRITTEN
        JR      NZ,LP2  ;ALL 8 BITS ?
        POP     AF      ;IF SO
        POP     DE      ;RESTORE ALL
        POP     BC      ;THE REGISTERS
        POP     HL
        RET             ;RETURN TO CALLER

LP4     LD      HL,WRSP+1   ;GET DJNZ4
```

```
Ø1ØØØ          LD      B,(HL)   ;AND WASTE
Ø1Ø1Ø          DJNZ    $        ;SOME TIME
Ø1Ø2Ø          JR      LP3      ;GO BACK TO MAIN PROGRAM
Ø1Ø3Ø
Ø1Ø4Ø PULSE    LD      HL,ØFCØ1H  ;POSITIVE CONTROL WORD
Ø1Ø5Ø          CALL    Ø221H    ;WRIT POSITIVE PULSE
Ø1Ø6Ø          LD      B,ØBH    ;DELAY
Ø1Ø7Ø          DJNZ    $        ;138 'T' STATES
Ø1Ø8Ø          LD      HL,ØFCØ2H  ;NEGATIVE CONTROL WORD
Ø1Ø9Ø          CALL    Ø221H    ;WRITE NEGATIVE PULSE
Ø11ØØ          LD      B,ØBH    ;DELAY
Ø111Ø          DJNZ    $        ;138 'T' STATES
Ø112Ø          LD      HL,ØFCØØH ;TERMINATOR CONTROL WORD
Ø113Ø          CALL    Ø221H    ;WRITE TERMINATOR
Ø114Ø          LD      HL,WRSP  ;GET DJNZ3
Ø115Ø          LD      B,(HL)   ;AND DELAY
Ø116Ø          DJNZ    $        ;AWHILE
Ø117Ø          RET              ;RETURN TO CALLER
Ø118Ø
Ø119Ø READ     PUSH    BC       ;SAVE REGISTERS
Ø12ØØ          PUSH    HL       ;USED
Ø121Ø          LD      B,Ø8H    ;READ 8 BITS PER BYTE
Ø122Ø          CALL    RDBIT    ;READ 1 OF THE BITS
Ø123Ø          DJNZ    $-3      ;DONE 8 TIMES?
Ø124Ø          POP     HL       ;RESTORE
Ø125Ø          POP     BC       ;REGISTERS USED
Ø126Ø          RET              ;RETURN TO CALLER
Ø127Ø
Ø128Ø RDBIT    PUSH    BC       ;SAVE NEEDED
Ø129Ø          PUSH    AF       ;REGISTERS
Ø13ØØ          IN      A,(ØFFH)   ;LOOK FOR
Ø131Ø          RLA              ;SYNCH PULSE
Ø132Ø          JR      NC,$-3   ;DO UNTIL FOUND
Ø133Ø          LD      HL,RDSP  ;GET DJNZ1
Ø134Ø          LD      B,(HL)   ;AND DELAY
Ø135Ø          DJNZ    $        ;AWHILE
Ø136Ø          CALL    Ø21EH    ;RESET FLIP/FLOP
Ø137Ø          LD      HL,RDSP+1   ;GET DJNZ2
Ø138Ø          LD      B,(HL)   ;AND DELAY
Ø139Ø          DJNZ    $        ;AWHILE
Ø14ØØ          IN      A,(ØFFH)   ;CHECK FLIP/FLOP
Ø141Ø          LD      B,A      ;SAVE IN 'B'
Ø142Ø          POP     AF       ;RESTORE 'A' FROM STACK
Ø143Ø          RL      B        ;CHECK TO SEE IF
Ø144Ø          RLA              ;FLIP/FLOP WAS SET
Ø145Ø          PUSH    AF       ;SAVE RESULTS ON STACK
Ø146Ø          CALL    Ø21EH    ;RESET FLIP/FLOP
Ø147Ø          POP     AF       ;RESTORE
Ø148Ø          POP     BC       ;REGISTERS
Ø149Ø          RET              ;RETURN TO CALLER
Ø15ØØ
Ø151Ø SYNCH    PUSH    HL       ;SAVE ON STACK
Ø152Ø          XOR     A        ;LOAD 'A' WITH Ø
Ø153Ø          CALL    RDBIT    ;READ FROM TAPE
Ø154Ø          CP      ØA5H     ;IS IT THE ØA5H BYTE?
Ø155Ø          JR      NZ,$-5   ;NO----KEEP TRYING
Ø156Ø          LD      A,2AH    ;'*' TO 'A' REGISTER
Ø157Ø          LD      (3C3EH),A   ;AND DISPLAY
Ø158Ø          LD      (3C3FH),A   ;ON VIDEO
Ø159Ø          POP     HL       ;RESTORE 'HL'
Ø16ØØ          RET              ;RETURN TO CALLER
```

Program continued

```
01610
01620 RDSP     DEFW    412BH    ;1000 BITS/SECOND
01630                           ;DJNZ4 AND DJNZ3
01640 WRSP     DEFW    4117H    ;1000 BITS/SECOND
01650                           ;DJNZ2 AND DJNZ1
01660
01670 TAPE     CALL    WRCMD    ;ZBUG SUBROUTINE TO
01680          DEFM    ' (F/S) ,'  ;WRITE MESSAGE
01690          CALL    GETCH    ;ZBUG SUBROUTINE
01700                           ;TO GET REPLY
01710          CP      'F'      ;IS REPLY AN 'F'
01720          JR      Z,FAST   ;YES---GOTO FAST
01730          LD      HL,8560H  ;OTHERWISE LOAD
01740          LD      (RDSP),HL ;RDSP AND WRSP
01750          LD      HL,875CH  ;WITH SLOW
01760          LD      (WRSP),HL ;SPEED VARIABLES
01770          RET               ;RETURN TO CALLER
01780
01790 FAST     LD      HL,412BH  ;LOAD RDSP
01800          LD      (RDSP),HL ;AND WRSP
01810          LD      HL,4117H  ;WITH FAST
01820          LD      (WRSP),HL ;SPEED VARIABLES
01830          RET               ;RETURN TO CALLER
01840
01850 COPY     CALL    OUTSTR   ;NEED MORE ROOM
01860          CALL    TAPE     ;IN ZBUG PROGRAM
01870          RET              ;RETURN TO CALLER
01880
01890 WRITE    CALL    TAPE     ;NEED MORE ROOM
01900          JP      SETUP2   ;AGAIN
01910          END     4338H    ;ZBUG STARTING POINT
*
```

30

Blinking and Repeating on the Model I

by Craig A. Lindley

System Requirements:
Model I
16K RAM
One disk drive
TRSDOS-compatible DOS

The Model I, unlike newer and more expensive computers, lacks a blinking cursor and repeating keys. This utility adds these capabilities to your Model I. Like most other special keyboard drive routines, NEWDVR patches itself into the keyboard device control block (DCB) so that it, not the normal keyboard driver routine, is executed when the keyboard is polled. The computer is continually polling the keyboard in order to respond to input immediately.

Essentially, NEWDVR directs the computer to:

- Blink cursor on then off until a key is pressed.
- Transmit the valid key code immediately to the operating system.
- If the key is held down, delay before repeating the key.
- After delay is up, repeat key until key is released.

I have successfully tested this routine in BASIC and machine-language programs.

How It Works

The first portion of code, labeled PATCH, puts the address of the NEWDVR routine into the keyboard DCB (see Program Listing). The PATCH routine also places the address of the normal keyboard scan routine, taken from the DCB, into the NEWDVR code at two places, so you can call the keyboard scan routine to get keyboard characters from the operator. PATCH also protects NEWDVR from being overwritten, by storing its address, minus one, in the DOS top-of-memory pointer at 4049H.

The first part of the NEWDVR code checks to see if the routine calling the keyboard scan is the wait-for-key routine at 49H in ROM. If so, the blinking cursor routine is executed. If not, the normal key scan routine is initiated. This function is checked by looking back on the stack to see what the return address of the calling routine is. An address of 4CH, ten bytes back on the stack, indicates the routine at 49H is calling. Any other address indicates the calling program is doing a keyboard scan, probably just to check whether the BREAK key is active, not waiting for input. This feature was added because quite a few TRS-80 programs scan the keyboard constantly for a BREAK command. This is normally invisible, but becomes painfully obvious if the cursor has to blink before the calling program can continue execution.

If the NEWDVR routine decides that the blinking cursor routine should be executed, the first thing it does is turn off the normal cursor character, by outputting the cursor-off character code of 15 decimal to the ROM display routine at 33H. Then the address of the cursor is loaded into HL and the character at the current address of the cursor is loaded into register C for safekeeping. The new block cursor character (code 143 decimal) is stored over the original character at the current address of the cursor. The RDKEYS routine, described below, is called to read the keyboard repeatedly until either a key press is detected or a predetermined time period elapses. This time period is controlled by the BLINK equate in the listing.

The RDKEYS routine returns with the Z flag reset, if a key was detected; or set, if not. The original character at the cursor position is replaced. If the RDKEYS routine detected a key, control returns to the operating system with that character in the A register. If not, the RDKEYS routine is again called to see if a key has now been pressed. Control returns unconditionally to the operating system after this call, with the Z flag set accordingly. Calling the RDKEYS subroutine twice, first with the block cursor character at the cursor address, and then with the original character at the cursor address, causes the cursor to blink at a 50/50 duty cycle (half on, half off).

The RDKEYS routine performs the actual polling of the keyboard. The number of times it polls before returning to the NEWDVR routine is controlled by the BLINK time constant, which is contained in DC. This count decrements one each time the keyboard is polled and no key has been pressed. The delay count (IX) and the first-time flag (IX + 1) are reset to zero to indicate that a key was not found. The delay count determines how long after the key is held down the repeat function begins. The first-time flag is zero before a new key is pressed, and one afterwards.

If the BLINK count reaches 0FFH, or 255, before a key is detected, the RDKEYS routine returns to the NEWDVR routine with Z = 1 indicating this. Clearing the 7-byte keyboard work area at 4036H to zero before

polling the keyboard causes the normal keyboard driver routine to return a key code, even if the key has not been released. Normally, the keyboard driver routine does not return a key code until another key is pressed, or the original key was released and pressed again.

If the RDKEYS routine determines that a key has been pressed before the BLINK count is exhausted, control transfers to the FOUND routine for additional processing. There, the key character code is placed in the B register for temporary storage. The delay count is loaded into the accumulator and a comparison is done to see if the count equals zero. The count equals zero when a key is first pressed, or after the delay time counter has overflowed. If a key was just pressed, control transfers to F1, and the keyboard character stored in B is returned to the A register.

A test is performed to see whether this is a *new* keypress, signified by the first-time flag equaling zero. If so, the delay count is incremented to one and the first-time flag is set to one, so that these instructions are skipped the next time the F1 routine is entered. The F2 routine is executed whether or not this was the first time through F1. F2 resets the Z flag to indicate that a key has been pressed, before returning the key character in the A register to the NEWDVR routine and eventually to the operating system.

If the key remains pressed the next time the keyboard is polled, control does not pass to the F1 routine because the delay count is not zero. This causes the delay count to shift, the accumulator to clear, the Z flag to be set, and control to return to the NEWDVR routine. This means a delay before the keys start to repeat, because when the delay count doesn't equal zero, this routine passes the keyboard null code of 00 back to the operating system, just as if no keys were being pressed. When shifting the count causes the count to again equal zero, the F1 routine is executed again. This time, however, the F1 routine doesn't increment the delay count, so the keys repeat at full speed.

Using this Program

Place this program in memory one byte at a time, by using a monitor program such as DEBUG and writing it to tape or disk. Or, assemble it as a DOS/CMD file, using an editor/assembler. Change the program ORG, as shown on the listing, to reflect your computer's memory size. If your system is non-disk, change the jump to the operating system in line 250 of the listing to a return to BASIC (1A19H). Make sure the memory location of this program doesn't conflict with any other high memory programs.

Program Listing

```
                ;****************************************
                ;***         BLINKING CURSOR          ***
                ;***       REPEAT KEY UTILITY         ***
                ;***          VERSION  1.2            ***
                ;***       NOVEMBER 26, 1981          ***
                ;***              BY                  ***
                ;***        CRAIG A. LINDLEY          ***
                ;****************************************
                ;
                ;SYSTEM EQUATES
                ;
0400            BLINK   EQU     0400H           ;CURSOR BLINK TIME CONST.
0033            CHROUT  EQU     0033H           ;VIDEO CHAR OUT ROUTINE
4020            CURSOR  EQU     4020H           ;CURSOR ADDR STORAGE
4016            KEYDCB  EQU     4016H           ;KEYBOARD DCB
402D            OPSYS   EQU     402DH           ;DOS REENTRY POINT
4049            TOPMEM  EQU     4049H           ;DOS TOP MEM PTR
4036            WKAREA  EQU     4036H           ;KEY DVR WORK AREA
                ;
                ;**********
                ;PROGRAM ORGS FOR VARIOUS MEMORY SIZES
                ;48K - FF70H
                ;32K - BF70H
                ;16K - 7F70H
                ;**********
                ;
FF70                    ORG     0FF70H
                ;
                ;**********
                ;START OF PROGRAM
                ;**********
                ;
FF70 2A1640     PATCH   LD      HL,(KEYDCB)     ;GET NORM KEY DRIVER ADDR
FF73 2206FF             LD      (SCAN2+1),HL    ;PLACE IN CODE FOR CALL
FF76 2296FF             LD      (NEWD1+1),HL
FF79 2188FF             LD      HL,NEWDVR       ;GET NEW DVR ADDR
FF7C 221640             LD      (KEYDCB),HL     ;PLACE IN KEYBOARD DCB
FF7F 2187FF             LD      HL,NEWDVR-1     ;MEMORY PROTECT LIMIT
FF82 224940             LD      (TOPMEM),HL     ;STORE FOR DOS
FF85 C32D40             JP      OPSYS           ;BACK TO OPSYS
                ;
                ;**********
                ;NEW KEYBOARD DRIVER ROUTINE
                ;**********
                ;
FF88 ED73B3FF   NEWDVR  LD      (STKPTR),SP     ;GET STACK PTR ADDR
FF8C DD2AB3FF           LD      IX,(STKPTR)     ;INTO IX
FF90 3E4C               LD      A,4CH           ;LSB OF CALL TO 49H
                                                ;RET ADDRESS
FF92 DDBE0A             CP      (IX+10)         ;CALL FROM 49H ?
FF95 C20000     NEWD1   JP      NZ,$-$          ;IF NOT THEN
                ;
FF98 DD21B1FF           LD      IX,STATUS       ;PT AT STATUS
FF9C 3E0F               LD      A,15            ;CURSOR OFF CODE
FF9E CD3300             CALL    CHROUT          ;OUTPUT CODE
FFA1 2A2040             LD      HL,(CURSOR)     ;GET CURSOR LOCATION
FFA4 4E                 LD      C,(HL)          ;GET CHAR AT CURSOR
FFA5 3E8F               LD      A,143           ;BLOCK CURSOR CODE
FFA7 77                 LD      (HL),A          ;STORE AT CURSOR LOCATION
```

```
FFA8 CDB5FF   00690        CALL   RDKEYS        ;READ KEYBOARD
FFAB 71       00700        LD     (HL),C        ;PUT ORIGINAL CHAR AT
              00710                             ;CURSOR BACK
FFAC C0       00720        RET    NZ            ;IF KEY FOUND THEN
FFAD CDB5FF   00730        CALL   RDKEYS        ;READ KEYBOARD AGAIN
FFB0 C9       00740        RET
              00750 ;
              00760 ;SYSTEM STORAGE LOCATIONS
              00770 ;
0001          00780 STATUS DEFS   1             ;DELAY COUNT
0001          00790        DEFS   1             ;1ST TIME FLAG
0002          00800 STKPTR DEFS   2             ;STACK PTR STORAGE
              00810 ;
              00820 ;***********
              00830 ;SUBROUTINES
              00840 ;***********
              00850 ;
FFB5 110004   00860 RDKEYS LD     DE,BLINK      ;LOAD TIME CONSTANT
FFB8 E5       00870 SCAN   PUSH   HL            ;SAVE REGS
FFB9 D5       00880        PUSH   DE
FFBA C5       00890        PUSH   BC
FFBB 213640   00900        LD     HL,WKAREA     ;CLEAR KEYBOARD WORK AREA
FFBE 0607     00910        LD     B,7           ;TO MAKE DRIVER RETURN A
FFC0 3600     00920 SCAN1  LD     (HL),0        ;KEY CODE EVERYTIME IT IS
FFC2 23       00930        INC    HL            ;CALLED.
FFC3 10FB     00940        DJNZ   SCAN1
FFC5 CD0000   00950 SCAN2  CALL   $-$           ;READ KEYBOARD USING
              00960                             ;NORMAL KEY DRIVER
FFC8 B7       00970        OR     A             ;NO KEY PRESSED ?
FFC9 2008     00980        JR     NZ,SCAN3      ;IF KEY PRESSED THEN
FFCB DD360000 00990        LD     (IX),0        ;RESET DELAY COUNT
FFCF DD360100 01000        LD     (IX+1),0      ;RESET 1ST TIME FLAG
FFD3 C1       01010 SCAN3  POP    BC            ;RESTORE REGS
FFD4 D1       01020        POP    DE
FFD5 E1       01030        POP    HL
FFD6 2005     01040        JR     NZ,FOUND      ;IF KEY PRESSED THEN
FFD8 1B       01050        DEC    DE            ;DEC BLINK COUNT
FFD9 BA       01060        CP     D             ;BLINK TIME FINISHED ?
FFDA 20DC     01070        JR     NZ,SCAN       ;IF NOT READ KEYS AGAIN
FFDC C9       01080        RET
              01090 ;
FFDD 47       01100 FOUND  LD     B,A           ;SAVE KEY CHAR
FFDE DD7E00   01110        LD     A,(IX)        ;GET DELAY COUNT
FFE1 FE00     01120        CP     0             ;IS IT ZERO ?
FFE3 2806     01130        JR     Z,F1          ;IF YES THEN
FFE5 DDCB0026 01140        SLA    (IX)          ;SHIFT COUNT
FFE9 AF       01150        XOR    A             ;"A" = 0
FFEA C9       01160        RET
FFEB 78       01170 F1     LD     A,B           ;RESTORE CHAR
FFEC DDCB0146 01180        BIT    0,(IX+1)      ;1ST TIME ?
FFF0 2007     01190        JR     NZ,F2         ;IF NOT THEN
FFF2 DD3400   01200        INC    (IX)          ;BUMP COUNT
FFF5 DDCB01C6 01210        SET    0,(IX+1)      ;RESET 1ST TIME FLAG
FFF9 FE00     01220 F2     CP     0             ;SET NZ FLAG
FFFB C9       01230        RET
              01240 ;
              01250 ;
FF70          01260        END    PATCH
```

31

SYNC: Automatic Start and Memory Size Setting

by Theodore J. LeSarge

System Requirements:
Model I
16K RAM
Editor/assembler

I wrote SYNC to provide automatic start and automatic memory size setting for my tape-based BASIC programs. SYNC assigns a number to each program CSAVEd and lets you CLOAD it by entering its identification number. You can choose any number from 1–255 (except 165, a code used by the computer to signal the end of the header pulses used to synchronize the data pulse and the computer's clock).

It's easy to relocate the program. Just make sure the new origin in line 190 and the END statement in line 1160 are the same. Lines 200–210 reset the automatic start. Lines 220-250 answer the memory size question at power-up. The computer stores the memory size, minus two, in memory location 40B1H. The TRS-80 automatically sets string space to 50 bytes and stores that number at location 40A0H. The HL register pair is loaded with the location in memory of the label DEF, minus 52. This number is placed at 40A0H. The process then repeats, but minus two. This number is stored at 40B1H.

When your non-disk TRS-80 is ready, memory locations 4152H–41A5H are set to jump to the L3 (Disk BASIC only) error display. Since these locations are in user RAM, you can easily detour the interpreter and use disk commands to execute your own machine-language programs. Lines 270–320 do just that. These locations already contain the JP (195 decimal) op code; just enter the 2-byte address of your program's entry point.

Line 340 returns you to BASIC. Note that I used 06CCH rather than the popular 1A19H for the entry point. A jump to 1A19H often produces

the ?OM (out of memory) error when the next command in BASIC is executed. When you type DEF in the command mode, the computer jumps to the memory location specified in line 360. Line 620 uses a ROM routine at 01C9H to clear the video display. Lines 630–660 set the cursor to the eighth line of the screen, set up the HL register pair to the message address at line 1060, and use ROM routine 28A7H for display. Line 670 sets the HL pair to the start of the buffer location. Lines 680–800 allow up to three numbers to be entered without pressing ENTER. Line 690 uses the ROM keyboard scan operation.

The A register now contains the character(s) entered. This is compared with 0DH, the code for ENTER. If ENTER is pressed for the first number, the computer responds with the ?MO (missing operand) error. Lines 730–760 trap non-numeric input. When a number is entered, line 770 loads it into a buffer. Line 780 uses the ROM display location 033H. The character in the A register is displayed at the current cursor location. Line 790 moves the HL pair to the next memory location in the buffer, while line 800 decrements the B register and checks for a non-zero result. After three numbers are entered, the program loop falls through and line 810 is executed. If fewer than three numbers are entered, the program goes back to the keyboard scan. Lines 810 and 820 set the last location in the buffer to zero, used in the next instruction.

Decimal Conversions

When you enter a number in response to the computer's prompt, the program uses the ROM keyboard scan at 049H, and loads the A register with the ASCII value of your input. For decimal 145, these would be 31H, 34H, and 35H. Each number is converted to binary coded decimal (BCD) by subtracting 30H from the ASCII value. Then each digit is multiplied by the power of ten it represents. This is a long process; the ROM routine at location 2B02H does the work. Each number input is stored in a buffer. The buffer is terminated with a zero (lines 810 and 820), the HL pair is set to the beginning address of the buffer, and 2B02H is called. The result is put in the DE register pair.

You can use this routine for numbers up to 32767; numbers beyond that give you an error. Because this program uses numbers up to 255 (the maximum for a single register), the answer from 2B02H is in the E register. Line 860 stores this number in memory. Lines 870–920 check for a synchronization byte of less than one or more than 255. The A register is set to zero and the HL pair is loaded with 255. If the E register is equal to the A register or greater than the HL pair, you get an error message. Lines 950–1040 set up and display the error message. A delay routine holds the display for about three seconds before returning you to line 620 for another try. If everything is entered correctly, the operation returns to 370, which jumps to the BASIC command mode.

To save your BASIC program, type SAVE and press ENTER. A file name is not needed. The program jumps to line 390, the cassette recorder starts, a leader of 255 zeros is written to tape, and return points used by ROM are saved on the stack. Line 480 loads the A register with your next synchronization byte; this also goes on the tape. Line 490 jumps to the remainder of the normal CSAVE instructions in ROM. Your BASIC program is now saved on tape with its code number. Confirm the save with LOAD?.

To load a program type DEF, type the identification number and enter the word LOAD. Lines 510–600 start the cassette recorder, load the DE register pair, and compare the value in the DE register to what the TRS-80 reads from the tape. When there is a match, lines 570–590 display two asterisks in the upper corner. If one of them doesn't blink, you entered the wrong code number; press RESET to continue.

Now, for the automatic start: lines 1140–1160 place the instruction "jump to where HL points" at 41E2H. The END statement loads the program start into HL. Then the first system command calls 41E2H, normally C9H or a return function. When this program loads, the computer jumps to the start of the program. Lines 200 and 210 reset this location so the system command operates correctly the next time.

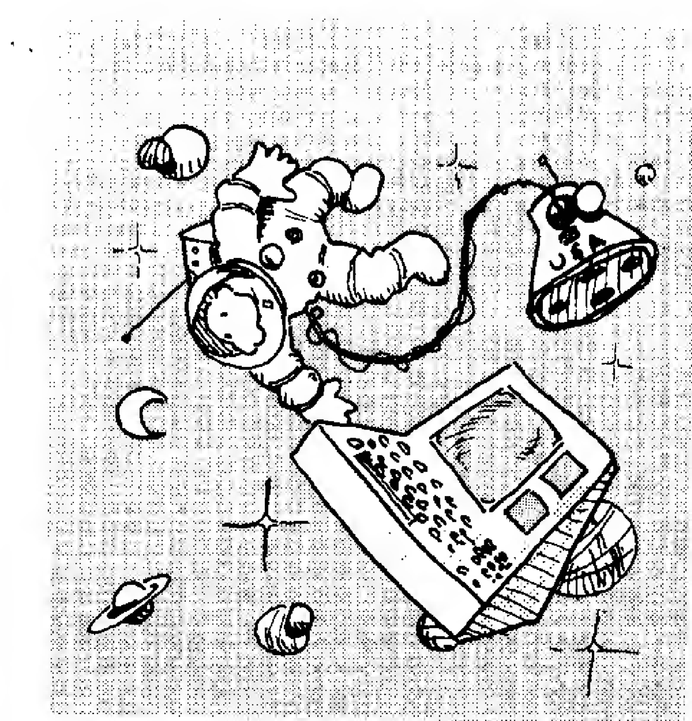
Program Listing

```
                00100 ;BASIC CODING PROGRAM
                00110 ;CREATES NEW SYNC BYTE
                00120 ;THEODORE J. LESARGE
                00130 ;6027 W. DECKER ROAD
                00140 ;LUDINGTON, MI. 49431
                00150 ;(616) 845-6905
                00160 ;JULY 20, 1981
                00170
                00180
7F20            00190         ORG     7F20H          ;32544
7F20 3EC9       00200         LD      A,0C9H         ;RESET
7F22 32E241     00210         LD      (41E2H),A      ; AUTO START
7F25 21157F     00220         LD      HL,DEF-52      ;SET
7F28 22A040     00230         LD      (40A0H),HL     ; STRING SPACE
7F2B 21477F     00240         LD      HL,DEF-2       ;SET
7F2E 22B140     00250         LD      (40B1H),HL     ; MEM SIZE
                00260 ;SET DISK BASIC ENTRY WORDS
7F31 214F7F     00270         LD      HL,CSAVE
7F34 22A141     00280         LD      (41A1H),HL     ;"SAVE" WORD
7F37 21687F     00290         LD      HL,LOAD
7F3A 228941     00300         LD      (4189H),HL     ;"LOAD" WORD
7F3D 21497F     00310         LD      HL,DEF
7F40 225C41     00320         LD      (415CH),HL     ;"DEF" WORD
7F43 CD491B     00330         CALL    1B49H          ;NEW
7F46 C3CC06     00340         JP      06CCH          ;READY//NOT 1A19H
                00350
7F49 CD827F     00360 DEF     CALL    SCN
7F4C C3CC06     00370         JP      06CCH          ;READY
```

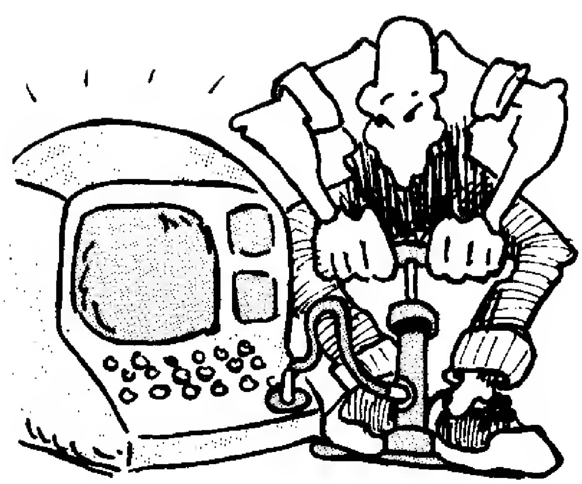
```
                00380
7F4F 21CCØ6     ØØ39Ø CSAVE   LD      HL,Ø6CCH        ;RET POINTS
7F52 E5         ØØ4ØØ         PUSH    HL              ; ROM WILL
7F53 21FB2B     ØØ41Ø         LD      HL,2BFBH        ;  USE
7F56 E5         ØØ42Ø         PUSH    HL
7F57 CDFEØ1     ØØ43Ø         CALL    Ø1FEH           ;ON TAPE
7F5A Ø6FF       ØØ44Ø         LD      B,ØFFH          ;255
7F5C AF         ØØ45Ø         XOR     A               ; ØØØØØ'S
7F5D CD64Ø2     ØØ46Ø         CALL    Ø264H           ;WRITE
7F6Ø 1ØFB       ØØ47Ø         DJNZ    $-Ø3H           ;B=Ø?
7F62 3AFE7F     ØØ48Ø         LD      A,(SYNC)        ;NEW SYNC BYTE
7F65 C364Ø2     ØØ49Ø         JP      Ø264H           ;BACK TO ROM
                ØØ5ØØ
7F68 CDFEØ1     ØØ51Ø LOAD    CALL    Ø1FEH           ;ON TAPE
7F6B E5         ØØ52Ø         PUSH    HL
7F6C CD41Ø2     ØØ53Ø         CALL    Ø241H           ;READ
7F6F ED5BFE7F   ØØ54Ø         LD      DE,(SYNC)       ;NEW SYNC BYTE
7F73 BB         ØØ55Ø         CP      E               ;A SAME AS E
7F74 2ØF6       ØØ56Ø         JR      NZ,$-Ø8H        ;NO? GO AGAIN
7F76 3E2A       ØØ57Ø         LD      A,2AH           ; *
7F78 323E3C     ØØ58Ø         LD      (3C3EH),A       ;SCREEN
7F7B 323F3C     ØØ59Ø         LD      (3C3FH),A       ;SAME+1
7F7E E1         ØØ6ØØ         POP     HL
7F7F C3222C     ØØ61Ø         JP      2C22H           ;BACK TO ROM
7F82 CDC9Ø1     ØØ62Ø SCN     CALL    Ø1C9H           ;CLS
7F85 21CØ3D     ØØ63Ø         LD      HL,3DCØH        ;SCREEN LOC
7F88 22204Ø     ØØ64Ø         LD      (4Ø2ØH),HL      ;SET CURSOR
7F8B 21D97F     ØØ65Ø         LD      HL,MESG1        ;SET PTR
7F8E CDA728     ØØ66Ø         CALL    28A7H           ;DISPLAY IN ROM
7F91 21FA7F     ØØ67Ø         LD      HL,BUFFER       ;SET PTR
7F94 Ø6Ø3       ØØ68Ø         LD      B,Ø3H           ;THREE NUMBERS
7F96 CD49ØØ     ØØ69Ø         CALL    Ø49H            ;KEYBD SCN
7F99 FEØD       ØØ7ØØ         CP      ØDH             ;ENTER PRESSED?
7F9B 2811       ØØ71Ø         JR      Z,$+13H         ;YES! CONTINUE
                ØØ72Ø ;NUMBER TEST ROUTINE/NUMBERS ONLY
7F9D FE3Ø       ØØ73Ø         CP      Ø3ØH
7F9F FA967F     ØØ74Ø         JP      M,$-Ø9H
7FA2 FE3A       ØØ75Ø         CP      Ø3AH
7FA4 F2967F     ØØ76Ø         JP      P,$-ØEH
7FA7 77         ØØ77Ø         LD      (HL),A          ;NO. TO BUFF
7FA8 CD33ØØ     ØØ78Ø         CALL    Ø33H            ;DISPLAY IN ROM
7FAB 23         ØØ79Ø         INC     HL              ;BUMP ONE
7FAC 1ØE8       ØØ8ØØ         DJNZ    $-Ø16H          ;B=Ø? NO GO AGAIN
7FAE AF         ØØ81Ø         XOR     A               ;ZERO IN A
7FAF 77         ØØ82Ø         LD      (HL),A          ;DELIMITER FOR BUFF
7FBØ 21FA7F     ØØ83Ø         LD      HL,BUFFER       ;SET PTR
                ØØ84Ø ;ROM ROUTINE CONVERTS ASCII NUMERIC/RESULTS IN DE
7FB3 CDØ22B     ØØ85Ø         CALL    2BØ2H           ;VERY USEFUL
7FB6 ED53FE7F   ØØ86Ø         LD      (SYNC),DE       ;STORE
7FBA AF         ØØ87Ø         XOR     A               ;ZERO A REG
7FBB BB         ØØ88Ø         CP      E               ;E=Ø?
7FBC 28Ø7       ØØ89Ø         JR      Z,ERROR         ;YES/END
7FBE 21FFØØ     ØØ9ØØ         LD      HL,ØFFH         ;255 MAX NUMBER
7FC1 DF         ØØ91Ø         RST     18H             ;DE>HL?
7FC2 38Ø1       ØØ92Ø         JR      C,ERROR         ;YES IF CARRY
7FC4 C9         ØØ93Ø         RET
                ØØ94Ø
7FC5 21EC7F     ØØ95Ø ERROR   LD      HL,ERRMSG       ;SET PTR
7FC8 CDA728     ØØ96Ø         CALL    28A7H           ;DISPLAY
                ØØ97Ø ;DELAY ROUTINE FOR ERROR DISPLAY--ABOUT 3 SECONDS
7FCB Ø6Ø3       ØØ98Ø         LD      B,Ø3H           ;THREE LOOPS
```

Program continued

```
7FCD 21FFFF     00990           LD      HL,0FFFFH       ;65535
7FD0 2B         01000           DEC     HL              ;ONE LESS
7FD1 7C         01010           LD      A,H             ;H TO A
7FD2 B5         01020           OR      L               ;ZERO TEST
7FD3 20FB       01030           JR      NZ,$-03H        ;NOPE?
7FD5 10F6       01040           DJNZ    $-08H           ;B=0?
7FD7 18A9       01050           JR      SCN             ;BACK AGAIN
7FD9 45         01060 MESG1     DEFM    'ENTER CODE NUMBER '
7FEB 00         01070           DEFB    0               ;STOPS OUTPUT
7FEC 20         01080 ERRMSG    DEFM    '    (1 TO 255)'
7FF9 00         01090           DEFB    0
0004            01100 BUFFER    DEFS    04H             ;BUFFER LENGTH
7FFE 0000       01110 SYNC      DEFW    0               ;NEW SYNC BYTE STORE
                01120
                01130 ;SET UP FOR AUTO START
41E2            01140           ORG     41E2H           ;SET UP
41E2 E9         01150           JP      (HL)            ;  AUTO START
7F20            01160           END     7F20H
00000 TOTAL ERRORS
```



Index



31 all new tutorials and utilities

From the overflowing files of *80 MICRO*: The very best articles from files full of manuscripts too good to pass up. These 31 useful, clearly documented tutorials and utilities were chosen, edited, and formatted to last for years of practical computing. Beginning and advanced programmers alike will find time- and effort-saving articles for the TRS-80 Model I and Model III. From line drawing to debugging, from sorting routines to adding commands and automatic features, you'll find THE REST OF 80 a goldmine of useful information.

ISBN 0-88006-062-X

$9.97